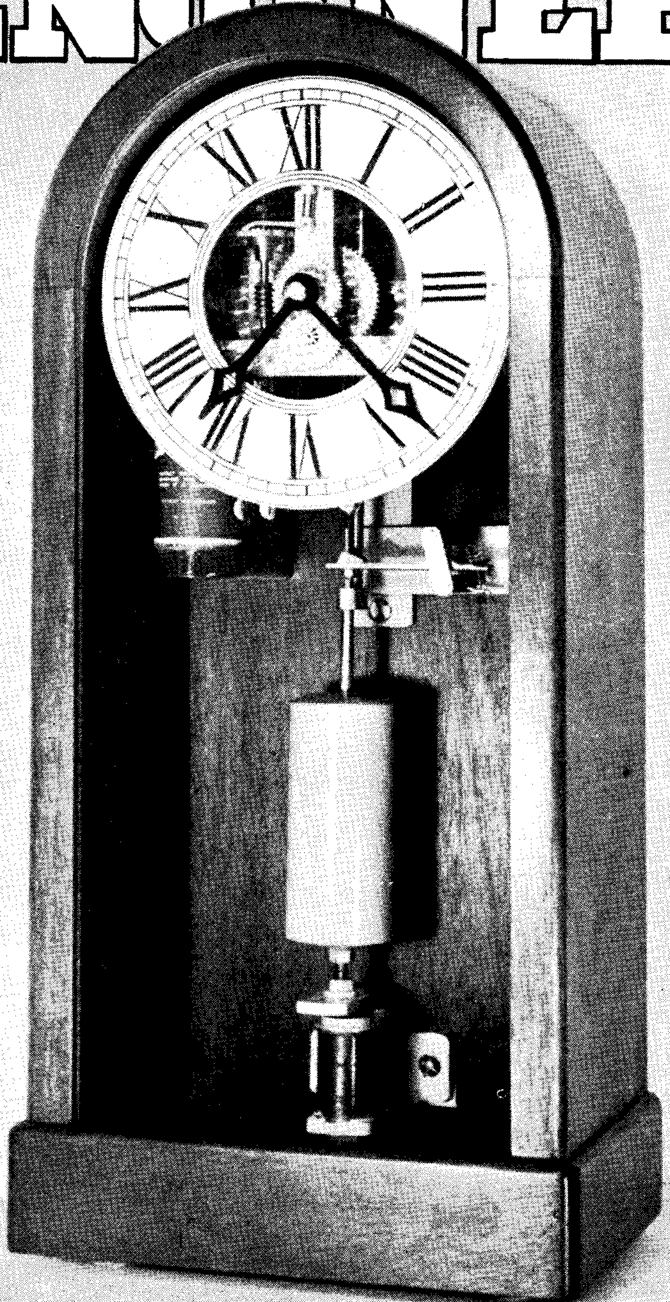
Vol. 106 No. 2662 THURSDAY MAY 29 1952 9d.

THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

29TH MAY 1952 VOL. 106 NO. 2662

Smoke Rings 687
A Half-seconds Electric Clock 689
The Maudslay Table Engine 693
Gas Poker Modifications 696
A Portable Tape Recorder 697
"Juliet" with Outside Valve Gear—Valve Gear—Return Cranks and Eccentric-rods 700
For the Bookshelf 703
Locomotives at the Northern Models Exhibition 704
Model Engineering After School .. 706
Models as Trophies 707
A Model Vertical Engine and Boiler .. 708
"Talking About Steam——" 5 : *Small and Medium-sized Stationary Engines* 709
In the Workshop—Fitting an Electric Motor to the Tailstock Drilling Spindle 713
Practical Letters 716
Club Announcements 718
"M.E." Diary 718

SMOKE RINGS

Good Propaganda

● AN AMERICAN reader, Mr. Robert Ebert, of Wooster, Ohio, U.S.A., has sent us an interesting clipping from *The Wooster Daily Herald*, which gives an account of a talk and demonstration given recently to a local club by Mr. Ebert. We are glad to note that the reporter concerned appears to possess a more enlightened outlook upon our hobby than is usual with newspapermen; the report reads :—

"There should have been a sign outside of the local Kiwanis meeting on Tuesday noon saying 'Genius At Work.' The work and demonstration of Robert Ebert on his hobby was truly the work of a genius.

"Bob's hobby is what he calls a 'creative hobby' in which one 'creates something from nothing.' Beginning from crude metals, he has made patterns, castings, and fabricated some thirty miniature models of steam engines, internal combustion engines, traction engines and similar productions. His masterpiece is a triple-expansion marine engine.

"It is necessary to 'see to believe' the creative skill of producing these models. They are more than miniatures for display. They are acting working models with all the motive ability of a large scale production of these pieces of machinery.

"Each miniature runs with the precision and accuracy of the large machine with gasoline or steam. His demonstration was certainly an evidence of the patience and skill of a real model engineer.

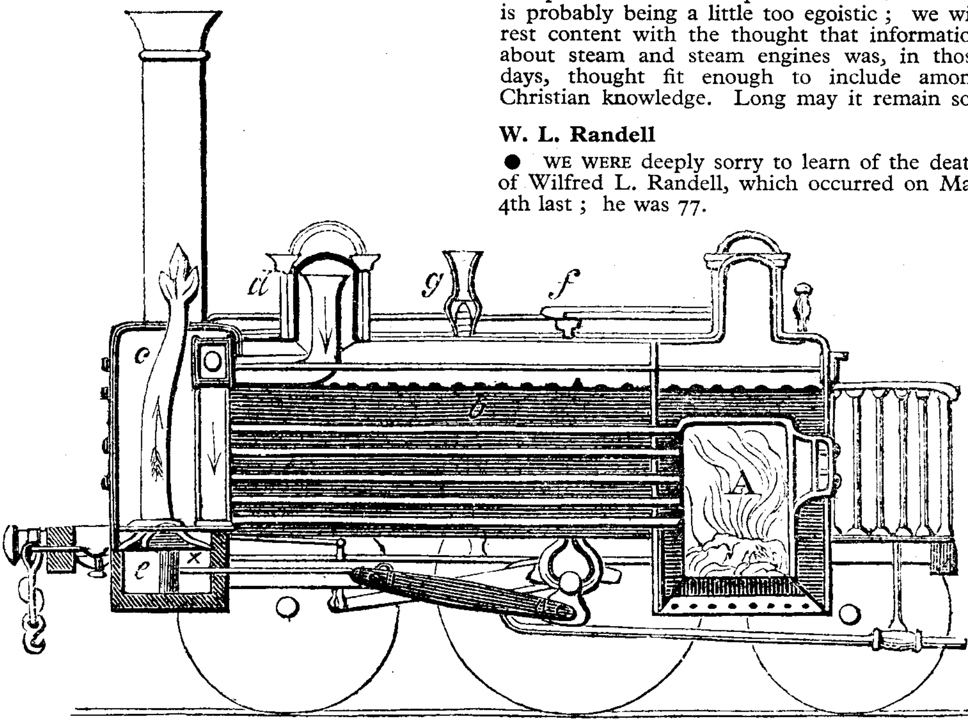
"Ebert said that his hobby was a demonstration of the use one can make of 2,500 to 3,000 hours that one has to waste a year. By hobbies of sports, collecting, photography, and creative hobbies one not only has happy hours of activity but also gives himself an interest at the time of his retirement. It also gives a sense of doing something different and being an authority upon something that gives a creative expression of the use of his spare time, according to Ebert."

We regard this kind of report as good propaganda for our hobby, and we wish that more reporters could be persuaded to cultivate a similar approach to model engineering. It is such a refreshing change from the "toy engines" and "playing trains" attitude so often displayed in newspaper reports!

Incidentally, we happen to know that Mr. Ebert's triple-expansion marine engine was built to the design by O. B. Bolton, of Sydney, Australia, drawings for which are available from our sales department.

Christian Knowledge

● WE HAVE recently had on loan from Mr. Ronald H. Clark a most interesting little paper-covered book entitled *Steam and the Steam Engine*; it is in excellent preservation, considering that it dates from not earlier than 1846 or, apparently, later than 1851. No author is either named or acknowledged, but it was published, according to the cover and title page, by the " Society for Promoting Christian Knowledge: sold at the Depository, Great Queen Street, Lincoln's Inn Fields: 4, Royal Exchange; 16, Hanover Street, Hanover Square; and by all Booksellers. Price Sixpence."



It was, without doubt, well worth the price! There is much useful information in it, especially for the novice, even if the language seems quaint in these modern times. For example, in the description of the locomotive, we read: " Behind the fire-box, and within reach of the engineer, as he stands on the platform, are several handles; one opens a small vent, through which the steam escapes with a shrill noise, and is forced against a brass bell which has no clapper. This is the steam-whistle."

Lovely! And, incidentally, this appears to be the only sentence in all the 58 pages of the book (*price 6d.*!) which gives a definite clue to its date; for the steam whistle was not fitted before 1846.

There are nine illustrations reproduced from line-drawings of engines of various kinds; one of the two locomotive drawings we reprint here. We think our readers will enjoy it as much as we have done. The shape and position of the blastpipe are especially intriguing; and do we see here an early anticipation of the multi-jet nozzle? Perhaps not; it is simply a fanciful impression of a flame, but why it should appear at the blast nozzle rather than at the top of the chimney is a problem we have not yet solved!

Finally, we are wondering whether " The Depository, Great Queen Street," by any chance, occupied the site of our present offices. But this is probably being a little too egoistic; we will rest content with the thought that information about steam and steam engines was, in those days, thought fit enough to include among Christian knowledge. Long may it remain so!

W. L. Randell

● WE WERE deeply sorry to learn of the death of Wilfred L. Randell, which occurred on May 4th last; he was 77.

Mr. Randell was an old friend of the " M.E." and contributed to its pages, from time to time, over a period of nearly fifty years. He was keenly interested in model engineering and allied subjects, his articles and letters always containing something of value. He specialised in the repair of watches and clocks and was the author of our two handbooks on this subject. He was something of an expert on the history of technology, and his last notable contributions to our pages were some articles written under the general title of " Men Like Ourselves," in which he sketched the lives of men like Sir Charles Parsons, George Westinghouse, and others whose names are world-famous in history.

He was a regular visitor to the MODEL ENGINEER Exhibition, at one time reporting it for our pages and often contributing a critical survey of it. Personally, he was one of the most likeable of men, ever ready to help others out of difficulties by either good advice or practical aid, and he seemed always to look upon and to be inspired by the sunny side of life. He was known to many of the staff of Electrical Press Ltd. and Percival Marshall & Co. Ltd., by whom, among many other friends and acquaintances, he will be sadly missed.

A Half-seconds Electric Clock

by C. R. Jones

AFTER the completion of my last electric clock, and chimes, which were described in THE MODEL ENGINEER, another project was required to keep the wheels turning, and after some consideration it was decided to make still another electric clock, but this time one which would not have to be fastened to a wall, but could stand anywhere on a firm basis, where it was not likely to be disturbed.

The following description, drawings and photographs show the result, and the completed clock is shown in photograph No. 1, reproduced on the cover of this issue.

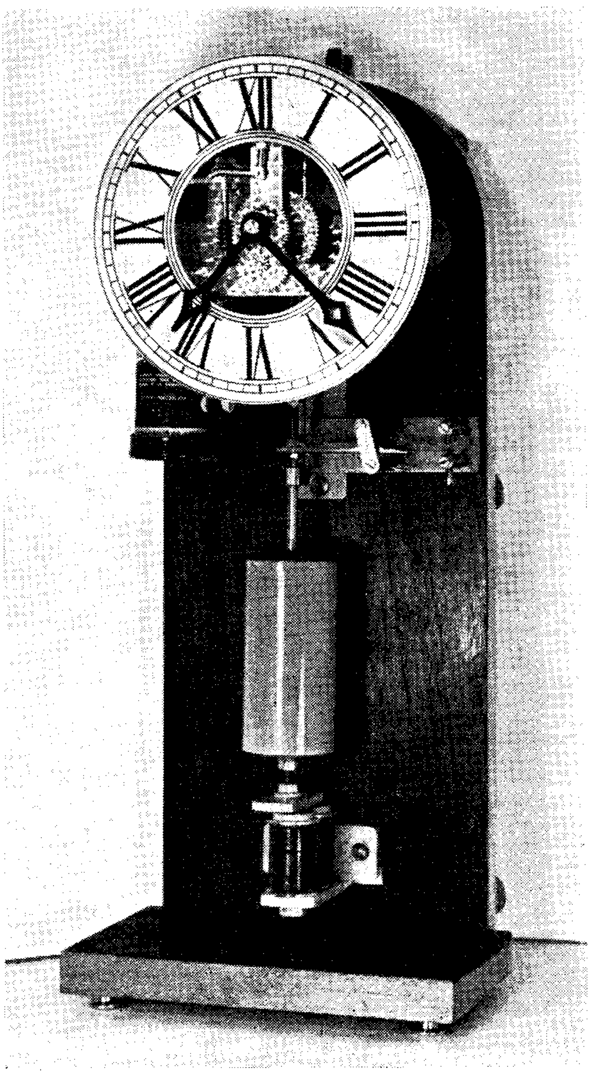
As will be seen, this clock is self-contained, and houses the 3-volt cycle lamp battery for driving it.

It is housed in a mahogany case with a rounded top, is pleasing in appearance, and has been quite satisfactory in operation.

This clock is $17\frac{1}{2}$ in. in height, 8 in. in width, $5\frac{1}{2}$ in. in depth including the case, the dial being 6 in. in diameter, the pendulum being a $\frac{1}{2}$-sec. one.

Although the general construction is very similar to the last clock, several modifications have been carried out to make it easier of construction.

Readers considering the construction of this clock are advised to read up my previous article which was published in THE MODEL ENGINEER on January 26th, February 2nd, the 9th, 16th and 24th, 1950. And also my " Notes on a Battery Driven Electric Clock," on July 6th, 1950, as it is not proposed in this article to go into too much detail, as most of the methods of construction used in my last clock were used in the making of this one.



Photograph No. 2. Clock with case removed

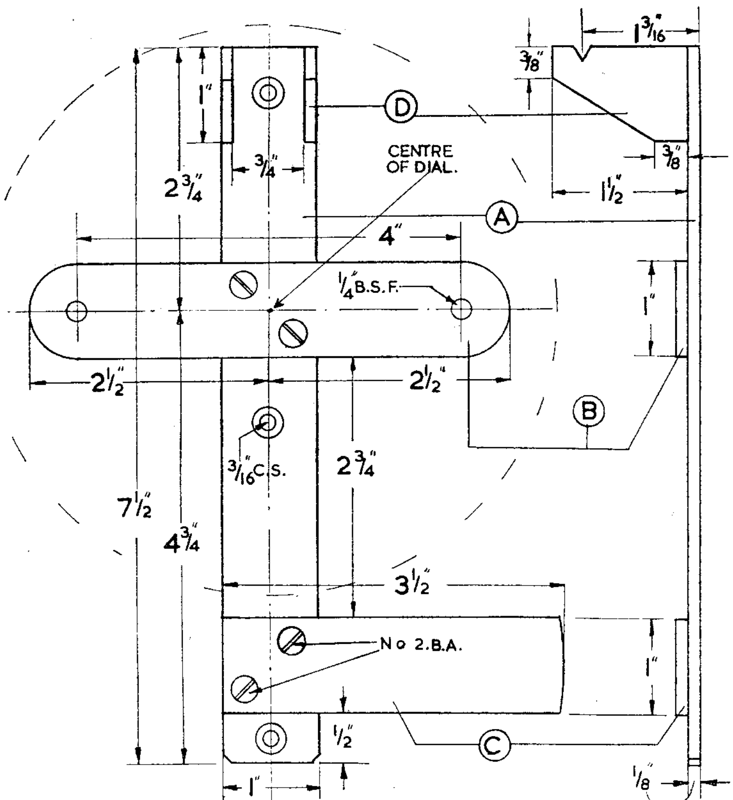
Two lathes were used in this clock's construction, the 3 in. " Winfield," mentioned in previous articles, also some work was done on my " Myford " M.L.7. Paradoxically, it seems that the smaller items were machined on the larger lathe, and vice versa.

If the previous article is referred to, it will be seen that the wheelwork is very similar, but the plates have been altered and their shape simplified ; and the main frame is of different formation. The operating pawl now works outside the front plate instead of between the plates, the count wheel teeth in this case projecting proud of the front plate.

A different form of make-and-break is employed, and the pendulum is cranked.

The Main Frame

This is shown on the appropriate drawing, and in the present case was made from 1 in. × $\frac{1}{8}$ in. flat B.M.S., this being available, but black iron or



MAIN FRAME FRONT.

SIDE

steel, or other suitable material can be used.

The pieces *A*, *B* and *C* were screwed together with No. 2 B.A. counter-sunk set-screws as shown, the portion *A* being drilled and tapped to receive them. The pendulum suspension bracket was made up of two pieces of the same material *D*, which were in this case silver-soldered to portion *A*, but if more convenient, this bracket could be bent up from one piece and screwed on to *A*, or made up from two separate angle pieces and similarly secured.

The two notches in the top were carefully filed as shown to a depth of about 5/32 in. and to a combined angle of 60 deg.

Three $\frac{3}{16}$ in. diameter countersunk holes were drilled in portion *A* where shown, to enable main frame to be securely fastened to the backboard.

It will be noticed that portion *C* is left blank except for the countersunk holes at the moment, but further treatment of this will be described later.

Backboard and Base

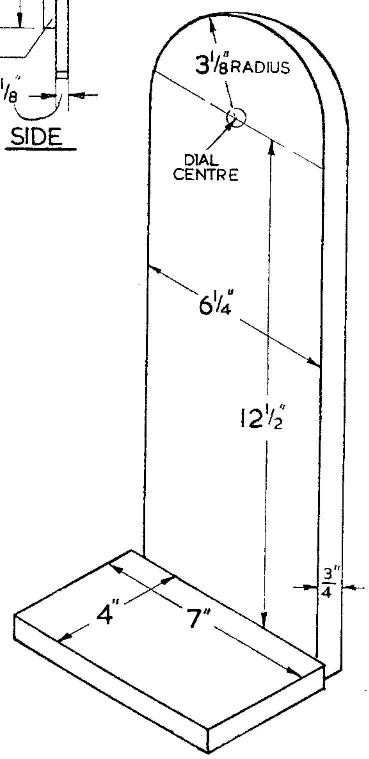
The backboard and base, were, in the present case, made from mahogany $\frac{3}{4}$ in. in thickness; the base being securely glued and screwed to the backboard. The sizes are shown on the drawing. Three brass feet were fixed to the baseboard, one in the centre of the front and two at the rear, as far apart as possible to ensure that the clock would stand firmly without any rock.

These feet can be seen in photograph No. 2, but it will be noticed that there are two in the front, one of these subsequently being moved to the centre and one being discarded, as four feet were used in the first place.

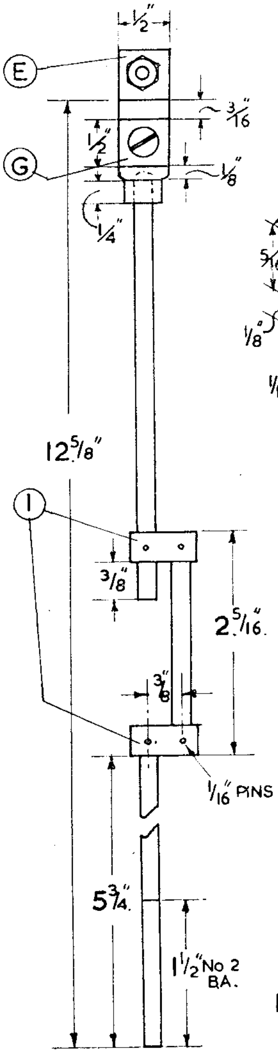
The clock case was made from the same material as the backboard, and some detail of its construction will be described later.

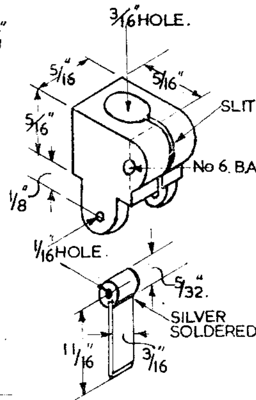
Pendulum-rod, Trigger Support, and Trigger

The pendulum-rod was made from $\frac{3}{16}$ in.

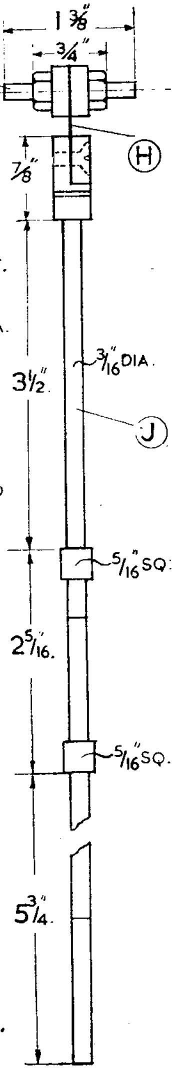


BACKBOARD. & BASE.

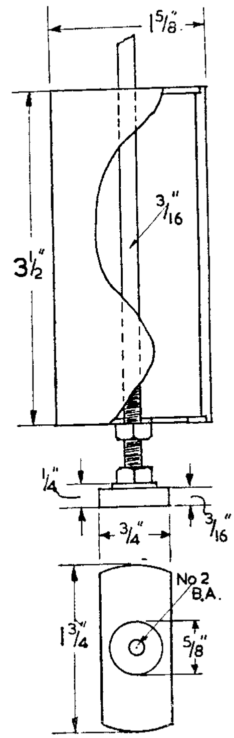




TRIGGER SUPPORT. & TRIGGER.



PENDULUM-ROD. & SUSPENSION.



PENDULUM BOB. & ARMATURE.

diameter silver-steel, to the dimensions shown, the top end being threaded for ¼ in. of its length No. 2 B.A. to screw into portion *G*, and the lower end being threaded for a length of 1½ in. to enable the pendulum bob to be adjusted and for the attachment of the armature.

For details of the construction of the cranked portion of the pendulum, and also the methods used in construction of trigger support and trigger, see "Notes on Battery Clock," July 6th, 1950.

Suspension

This is as shown on the drawing, the portion *E* being two ½ in. square pieces of mild-steel 3/16 in. in thickness drilled through their centres with a No. 2 B.A. clearance hole. Between these is clamped the suspension spring *H*, made from a length of 0.006 in. feeler blade ½ in. in width. The holes in this spring being punched by the same methods as before.

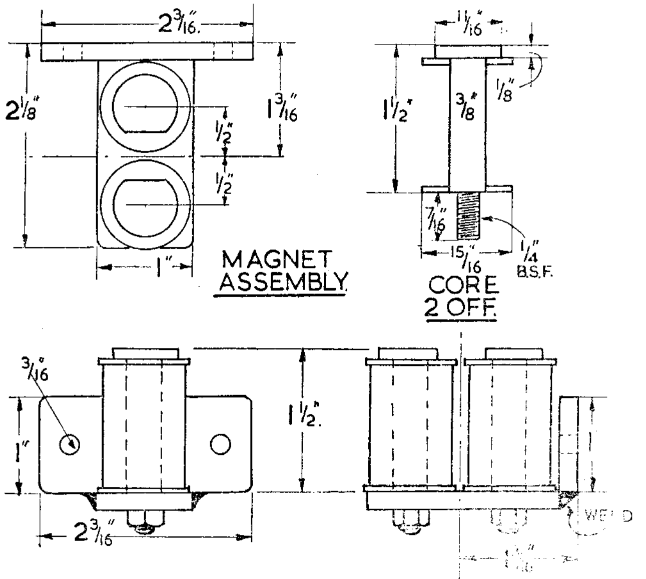
The supporting stud *F* was made from a length of steel rod threaded No. 2 B.A., the ends being turned down to just remove the thread. The whole was clamped together by means of two No. 2 B.A. nuts, the total width over the nuts being ¾ in. and a nice fit between the cheeks of the suspension bracket.

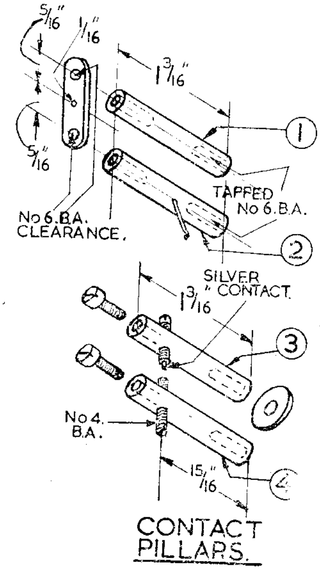
The clamp-piece *G* was made to the dimensions shown, of mild-steel, the top of the pendulum-rod was tightly screwed into it, and the suspension spring being secured by means of a No. 2-B.A. countersunk set-screw.

The suspension spring was made of a length to ensure that there was a gap of 3/16 in. between *E* and *G*.

Pendulum Bob

The pendulum bob was made from steel tubing as shown, the lower end being drilled with four ⅜ in. diameter holes for filling with lead. It will be noticed that slightly domed ends were used on my pendulum, as I happened to have two



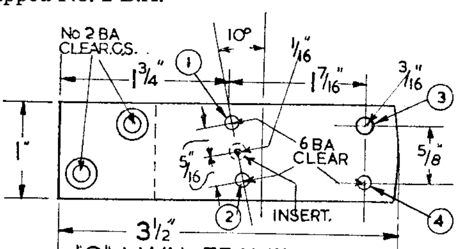


expansion or core plugs used in the motor trade, but flat ends are shown on the drawings.

The same methods were used for making this bob, and filling with lead as were used before (see previous article).

Armature

This was made to the sizes shown from $\frac{3}{4}$ in. $\times$ $\frac{1}{4}$ in. flat mild-steel. A boss being left $\frac{5}{8}$ in. in diamter in the centre, the rest being turned down to $\frac{3}{16}$ in. in thickness, the centre hole being tapped No. 2 B.A.



"C". MAIN FRAME.

Magnets

These were made from mild-steel to the dimensions shown, brass washers being soldered on the ends of cores $\frac{15}{16}$ in. in diameter by $\frac{1}{16}$ in. in thickness. Before this soldering process the whole of the steel parts were softened (see previous article).

The cores were insulated with brown paper, and in this case were wound with 10 layers of No. 26 gauge silk-covered instrument wire on each core, the ends of windings being connected up as described in previous article.

"C" Main Frame

Further operations were now carried out on portion *C* and holes Nos. 1, 2 and 4 were drilled No. 6 B.A. clearance. The hole marked $\frac{1}{16}$ in. and "insert" was drilled out $\frac{3}{16}$ in. in diameter and slightly chamfered on each side; after which a $\frac{3}{16}$-in. brass plug was riveted into postion and finished off flat with front and rear of *C*.

Hole No. "3 was now drilled $\frac{3}{16}$ in. to accommodate the insulated pillar "3."

The small plate forming the outer bearing of contact rocker (as shown on the drawing of contact pillars). This was of $\frac{1}{16}$ in. brass and was $\frac{5}{16}$ in. in width, and was drilled with two No. 6 B.A. clearance holes as shown, together with a $\frac{1}{16}$ in. diameter for the pivot on contact rocker spindle.

This plate was bolted to plate *C* by means of two No. 6 B.A. set-screws and nuts, and the $\frac{1}{16}$-in. hole drilled through into insert already mentioned, in order to ensure these holes being in line.

Contact Pillars

The four contact pillars were now made, the ones on the clock in question were hexagon brass rod $\frac{1}{4}$ in. across flats, but $\frac{1}{4}$ in. round rod has been shown on the drawings, as this is more likely to be available. The two pillars supporting the outer bearing for the rocker 1 and 2 were parted off $1\frac{3}{16}$ in. long and were drilled at each end and tapped No. 6 B.A. No. 2 pillar was drilled with a $\frac{1}{16}$ in. diameter hole about $\frac{1}{2}$ in. from its lower end, and a short length of $\frac{1}{16}$ in. diameter wire inserted with a small hook at the end, to act as a spring anchor.

(To be continued)

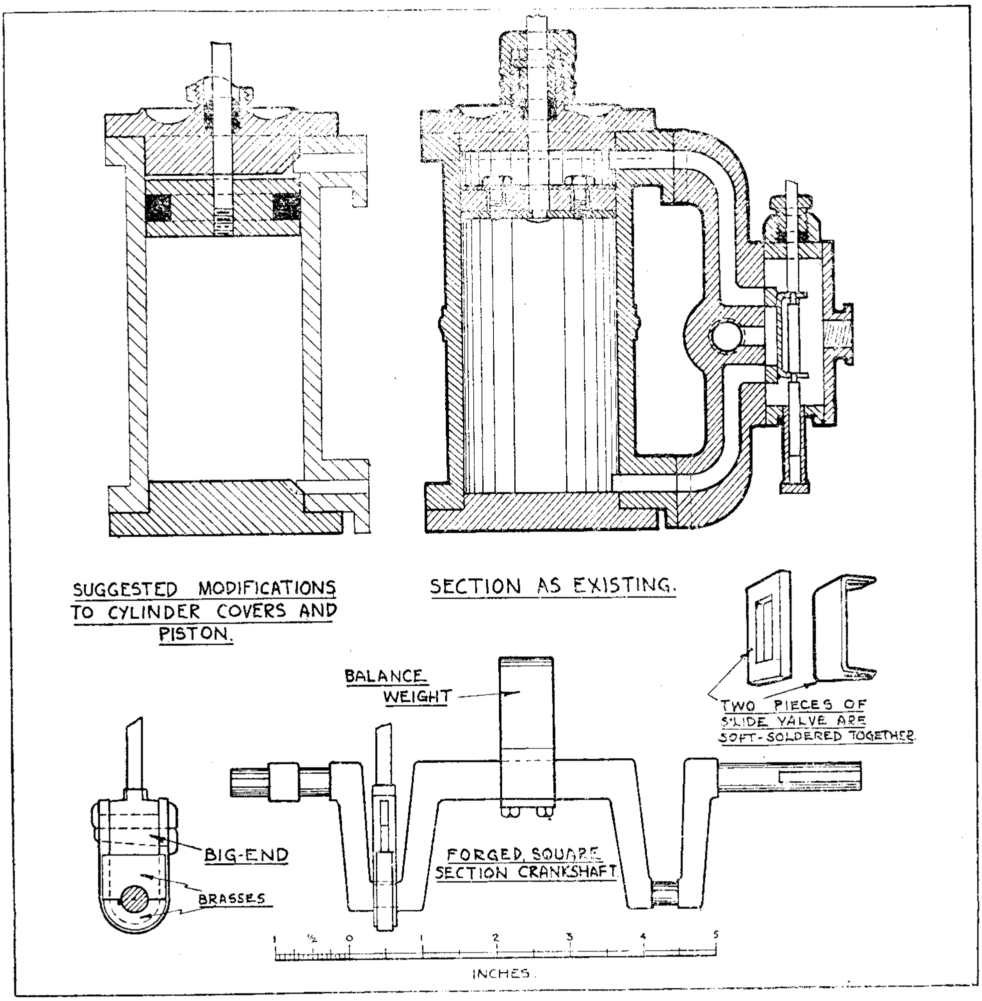
THE MAUDSLAY TABLE ENGINE

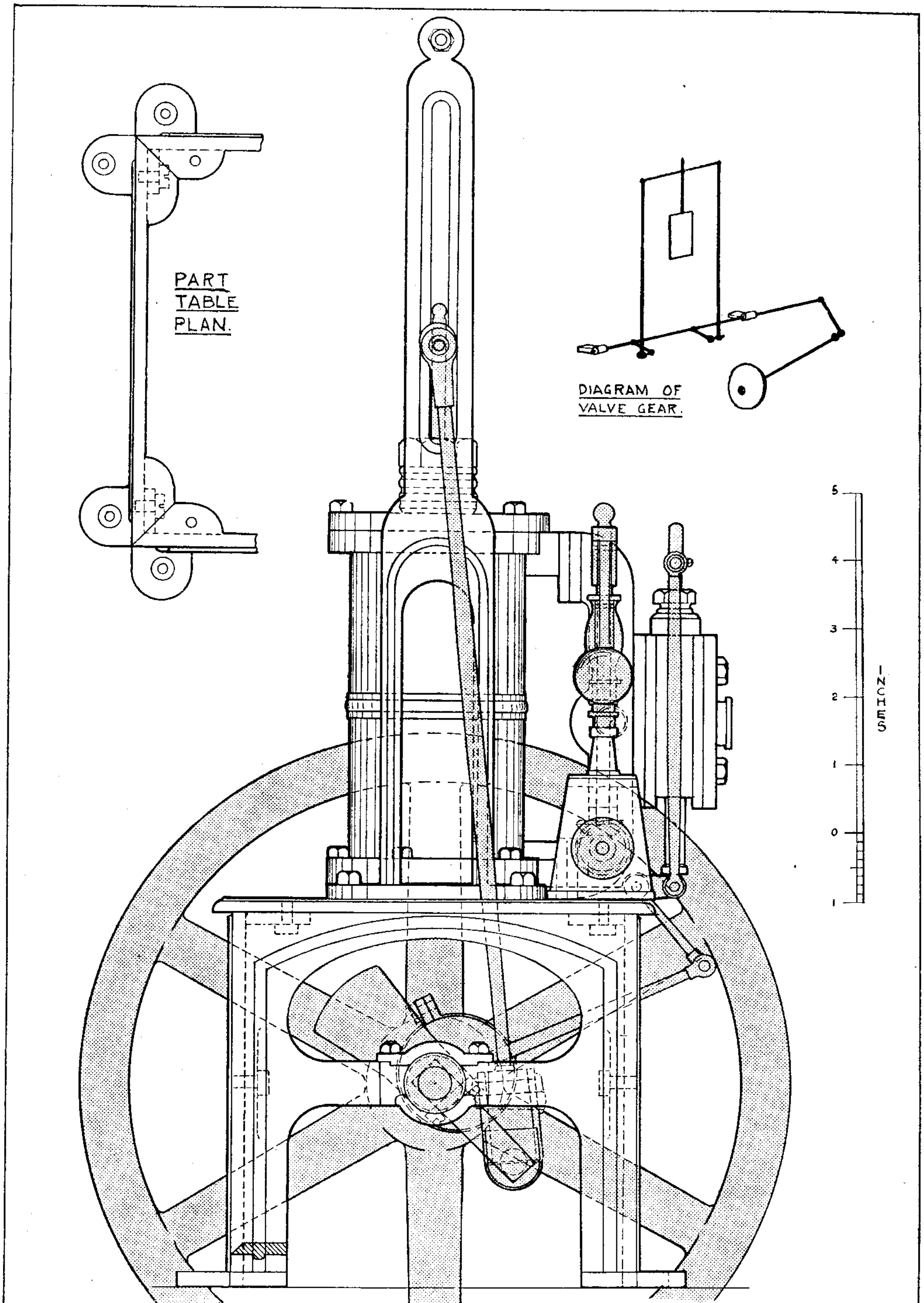
by A. R. Turpin

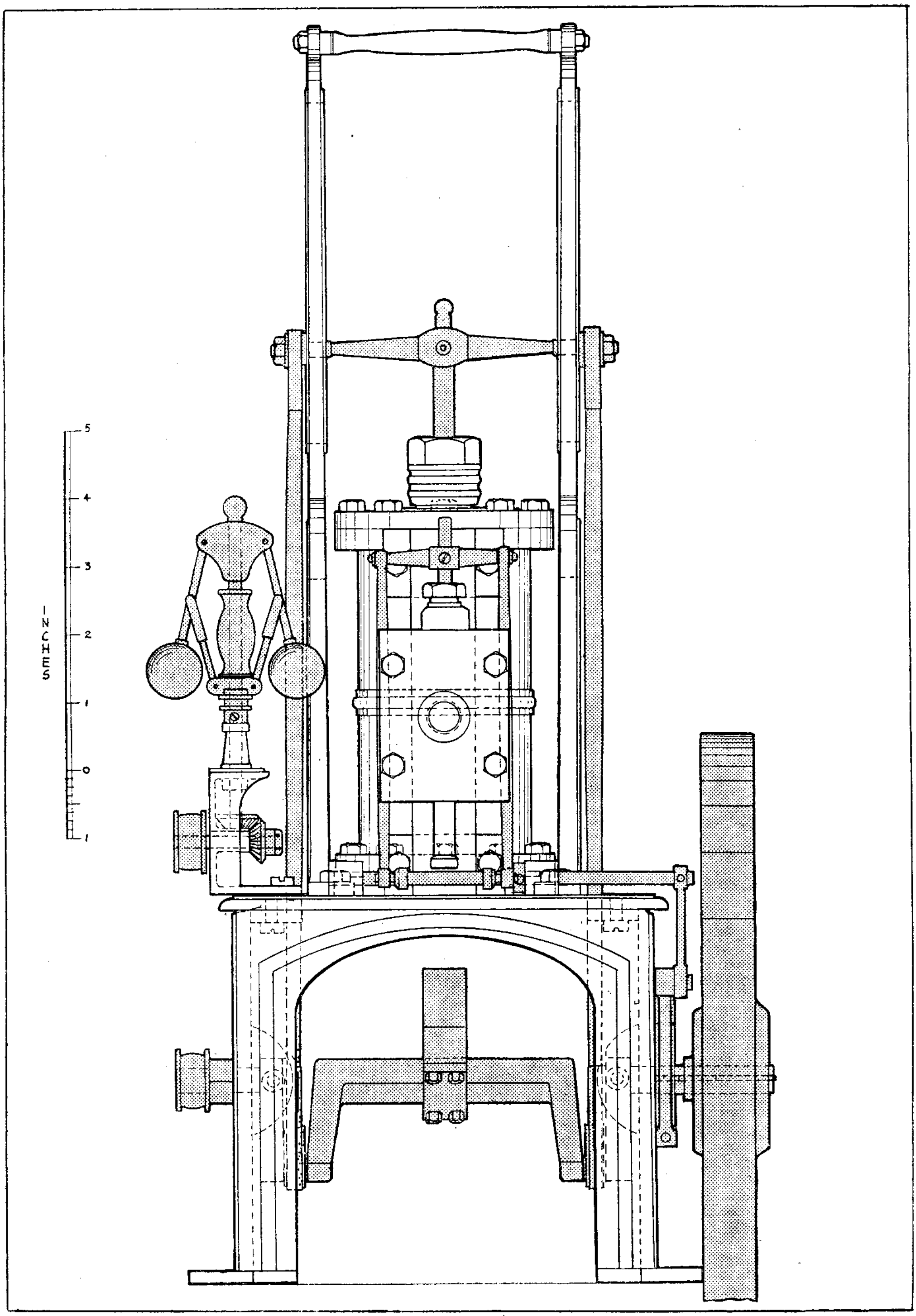
A CONSIDERABLE amount of interest has been shown in the Maudslay Table Engine which was illustrated on the cover of THE MODEL ENGINEER dated August 16th, 1951; and so, having obtained permission from the secretary of the Sutton Model Engineering Club, I have made some drawings of it.

As previously mentioned, the model is believed to be an authentic copy of an original engine, as it is known that the model is over seventy years old. The workmanship is not of a very high order, and it has been suggested that it was a task set to an apprentice; a not uncommon custom in those days. It would also seem likely that the interior details of the cylinder and the valves are not true copies of the full-size engine. For instance, the piston consists of a cast-iron disc sandwiched between two thin brass discs, one of which is riveted to the piston-rod; the constructor may have used this method as a means of obtaining true concentricity between the piston-rod and piston! Also, the section drawing shows the piston at the top of the stroke with about $\frac{5}{16}$ in. wasted steam space; this also applies to the bottom of the stroke as well.

A suggested modification to overcome this without altering the external dimensions is shown on the left; care should be taken that




PART
TABLE
PLAN.
DIAGRAM OF
VALVE GEAR.
5
4
3
2
1
0
1
INCHES


INCHES
5
4
3
2
1
0
1

this modification is only used to save steam and not increase the power, because it is unlikely that the long slender connecting-rods would stand such an increase.

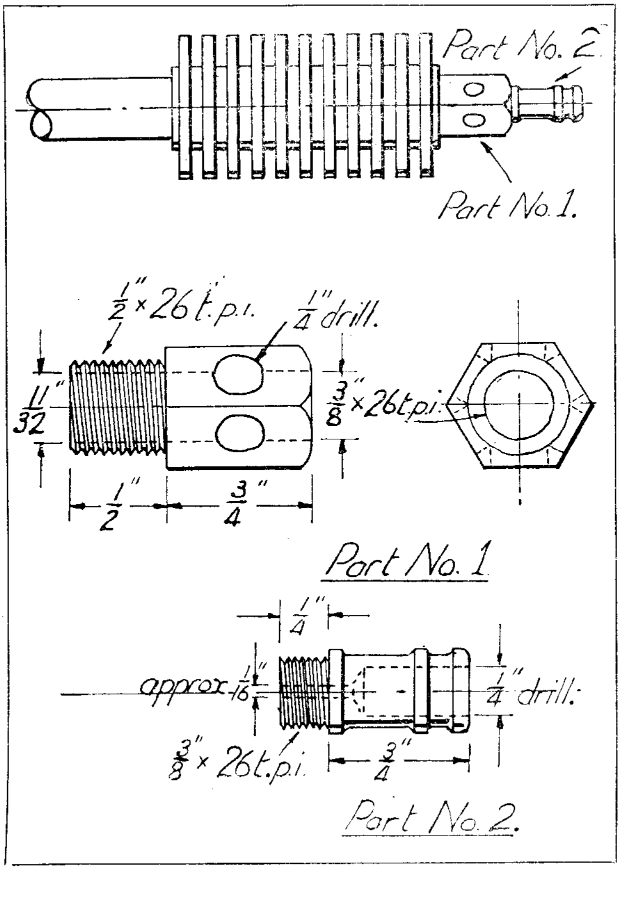
The governor definitely appears to be an afterthought, being tacked on by means of two cheese-headed screws, the workmanship would also appear to be by a different hand. There is no reason, however, why it should not be made to work in this position, a throttle being incorporated in the steam pipe, which could be used to support a fulcrum for the lever. It would be necessary to make the platform for the governor an integral part of the table top.

The table itself is made up of four separate sides mitred together and held by screws passing through lugs. The top is also held by screws passing through lugs in a like manner to those on the feet, but, of course, turned inwards.

Gas Poker Modifications

IN view of the letter recently published in THE MODEL ENGINEER by a prospective maker of the domestic gas poker described in the issue of December 6th, 1951, and because a number of such pokers are known to be under construction in the workshops of a local technical college, the writer feels called upon to describe the following modification carried out on the original version in the light of experience in using the poker.

Although the poker had been working satisfactorily, it was felt that the amount of air passing into the gas stream was insufficient, the nozzle illustrated in the drawings was, therefore, made and fitted, resulting in a considerable improvement to the working of the poker.



Part No. 1 was made from a short length of brass hexagonal bar measuring $\frac{5}{8}$ in. across the flats. It was mounted in the self-centring chuck, faced, chamfered and drilled 9/64 in. for a depth of $1\frac{1}{4}$ in. This was then tapped $\frac{3}{8}$ in. by 26 t.p.i., it being only necessary to form about a $\frac{1}{4}$ in. depth of full thread.

The bar was then parted off to a length of $1\frac{1}{4}$ in. and remounted in a reversed sense in the chuck. A length of $\frac{1}{2}$ in. was turned down to a diameter of $\frac{1}{2}$ in. and threaded $\frac{1}{2}$ in. by 26 t.p.i. The axial hole was then opened out to 11/32 in. diameter for a depth of 1 in., thus leaving $\frac{1}{4}$ in. of the hole threaded.

The partly machined component was then removed to the drilling machine and six $\frac{1}{4}$ in. holes drilled through the flats of the hexagon. This completed the work on Part No. 1.

Before starting, it had been found that the bore of the pipe used for the poker was just under $\frac{1}{2}$ in., there being enough metal to take an internal $\frac{1}{2}$ in. by 26 t.p.i. thread, sufficiently formed to hold the part No. 1. The existing holes drilled through the handle were covered by the simple expedient of tapping the tube a further $\frac{1}{8}$ in. through the handle thus displacing the position of the holes and so effectively covering them.

Part No. 2 was turned from a scrap piece of $\frac{7}{16}$ in. brass rod to the dimensions shown on the drawing. The small hole shown as approximately $\frac{1}{16}$ in. diameter should be found by trial on the existing gas supply. Start with a very small hole and progressively open it up until a good flame is obtained. This is not necessarily a large flame, but one having the characteristics of that produced by a bunsen, thus using only the amount of gas that may effectively consume the quantity of air introduced.—A. SMITH.

*A Portable Tape Recorder

With Notes on Magnetic Recording

by Raymond F. Stock

FIG. 13 shows the layout of the control mechanism. The main control shaft passes down through a rubber bush in the deck panel and through a bearing in the capstan platform. It is fitted with two cams both having about 300 deg. movement, and the shaft possesses a pinion geared 5 : 1 to a toothed sector. The latter is pinned to the switch shaft which operates a single Yaxley wafer supported on two pillars from the platform, this shaft having a 60 deg. travel. The end of the shaft projects below the switch and is fitted with the male half of a flexible coupling. This mates with a female member mounted on the Yaxley switch in the amplifier which controls the output circuits ; a mechanical link transmits movement to the input wafer under the chassis.

The complete mechanism is shown in Fig. 13 together with details of the cam followers and levers. Two levers pick up movement from the upper cam ; one shifts the pressure roller away from the capstan during rewind only, the other permits the permanent magnet to contact the tape during record only. The lower cam contacts an arm bolted to the capstan motor and shifts it away from the capstan during rewind only, and this enables the machine to be left for long periods in the ' Rewind " position, unused, without depressions appearing in the rubber rim of the flywheel.

It was found during initial tests that during recording and playback the rewind reel tended to drive its shaft even though unlocked from it. This caused an uneven frictional drag on the tape with disastrous results to recorded music (most probably due to badly meshed bevel gears). To obviate this effect the rewind drive shaft was locked during record and playback only, by arm (**A**) (Fig. 13) which, moving with the capstan motor, intercepts a cross member on the rewind drive-shaft.

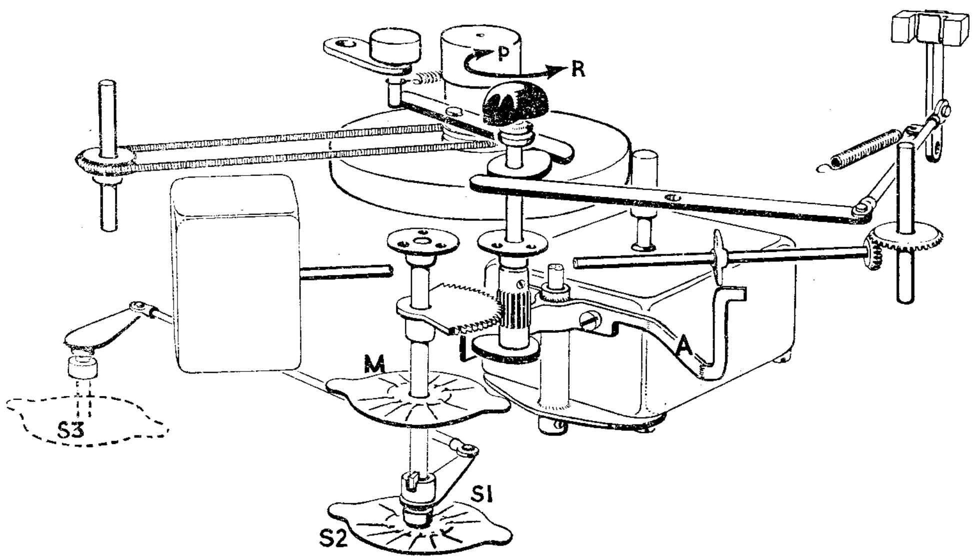


Fig. 13. *Deck mechanism and controls in " rewind " position. " M " is the motor-selector switch*

The remaining fittings below the tape deck are a pair of connection strips ; one supplies 240 V, a.c. for the motors and has a tag by which the deck is earthed to chassis, and the other supplies H.F. for the erase head. The connection to the record head is above the deck within the head cover.

The spring belt drive between capstan and take-up shaft is a standard cine item, its length being adjusted by trial and error until it gives the required slip around the take-up pulley. The tape should wind firmly, to an extent that may be gauged by the appearance of a new reel of tape as purchased.

*Continued from page 680, " M.E.," May 22, 1952.

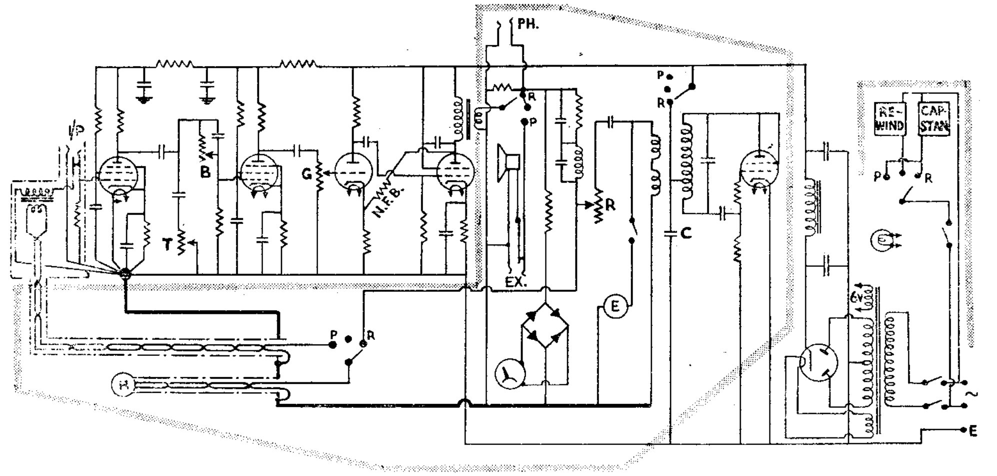


Fig. 14. Complete wiring diagram. The tint encloses the circuits associated solely with recording, the remainder of the components forming a conventional power supply and four-valve amplifier. "T," "B" and "G" refer to treble, bass and gain controls

The Amplifier

Fig. 14 shows the complete circuit laid out in a conventional arrangement. The last two amplifier stages have negative feed back between them as shown. The recording circuit incorporates a volume level meter reading output volts (a.c.) and this was calibrated by experiment when trials were completed. The meter series resistor was adjusted so that the needle showed a full scale reading on the largest signal that could be recorded without noticeable distortion. In the recording circuit feeding the head is placed a condenser and resistor in parallel—the resistor is intended to "swamp" the impedance of the head, and the condenser, by its reduced impedance at higher frequencies compensates for the drop in the tape characteristics on high notes.

The coil and condenser adjacent to this circuit

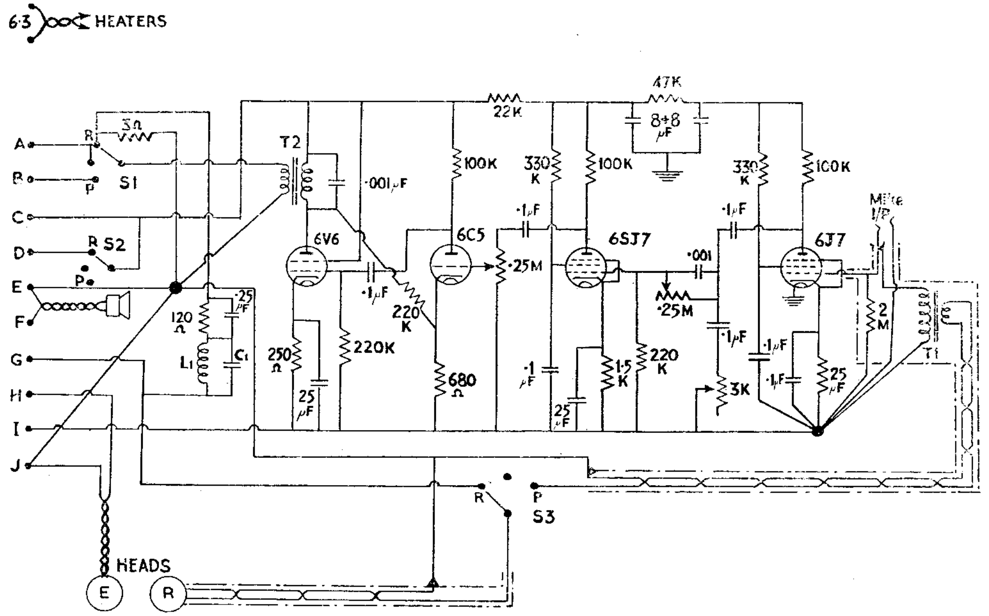
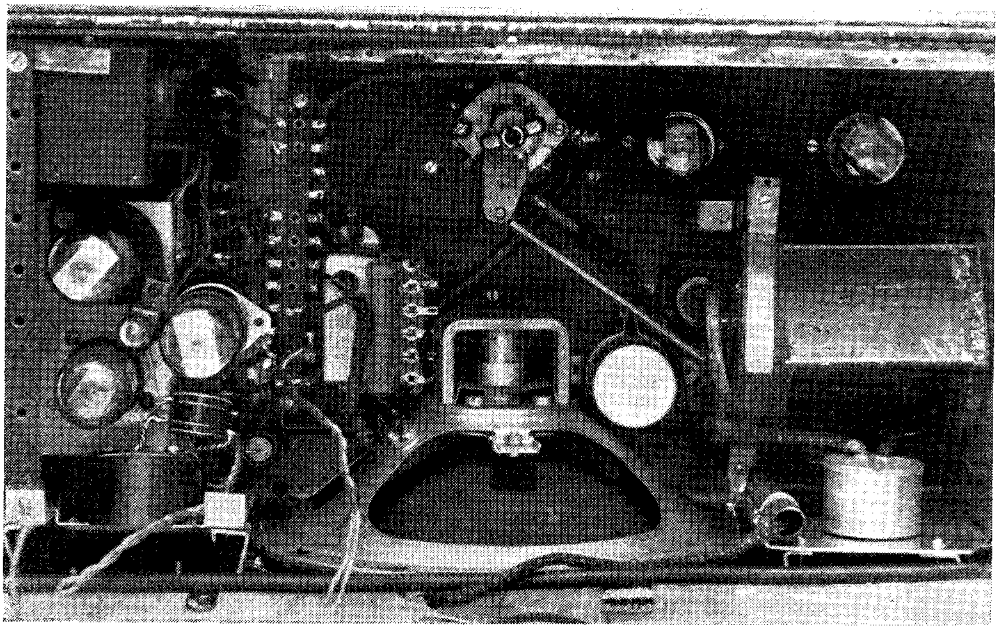


Fig. 15. Circuit of amplifier chassis. For values of C1, L1, T1, T2 see text



Interior of recorder

are tuned to the bias frequency and prevent bias from being dissipated in the output transformer. The variable resistor R is used to adjust bias to the optimum; a switch is incorporated in the erase lead for use when it is desired to superimpose one recording on another. The input socket is arranged for high impedance, but if a moving coil mike were to be used the jack could be inserted in the primary of the input transformer.

It will be seen that when changing the ganged switches from "Record" to "Playback" the power supply to the oscillator is broken before the head is disconnected from the bias supply. The condenser C then maintains an ever-decreasing H.F. which effectively demagnetises the head.

The heavy line in Fig. 14 indicates a common earth for all recording circuits, which is connected to chassis earth at the first valve. The complete circuit as shown is divided physically into two assemblies.

Fig. 15 shows the circuit of the amplifier portion and indicates most values. The output transformer (**T2**) is a standard 45 : 1 item and the input transformer (**T1**) a small 50 : 1 microphone transformer with mu-metal core. The latter component is enclosed in a thick mu-metal case inside another soft iron can.

The 3 ohm resistor (top left) replaces the speaker as load during recording and is wound from resistance wire (26-g.) on a flat paxolin strip $\frac{1}{2}$ in. wide. This forms a non-inductive resistor.

L1, the bias rejector coil has 150 turns of 28-g. copper wire (enamelled) wound on a $\frac{9}{16}$ in. diameter former in several layers to a length of 1 in. The parallel condenser **C1** is in the region of 0.35 micro Farad and the exact value was found by varying it until the output meter showed a nil reading when the oscillator was working. The output valve was removed during the adjustment to prevent the meter showing a reading from audio current.

(*To be continued*)

"Summer Pie" Coming Back

Summer Pie, Britain's favourite pre-war summer annual, makes a welcome reappearance on the nation's bookstalls on Thursday, June 12th.

An eye-catching full-colour cover painted by Harry Fairbairn introduces this bright publication in which the latest British and American joke cartoons, breezy non-fiction features, gay full-colour drawings and photographs and six complete stories by celebrated authors provide the ideal recipe for summer entertainment.

Ted Ray will add to his already considerable reputation as a laugh-raiser with his account of an exacting—but exciting—holiday; Elkan Allan writes on foreign film festival adventures; the mysteries of poteen-chasing in Ireland are revealed by Dennis Holman; and W. E. Armstrong contributes a lively account of an unusual holiday in the Basque country.

The 1952 *Summer Pie* sells at 1s. 6d., the entire profits going to the National Advertising Benevolent Society.

"JULIET" WITH OUTSIDE VALVE GEAR

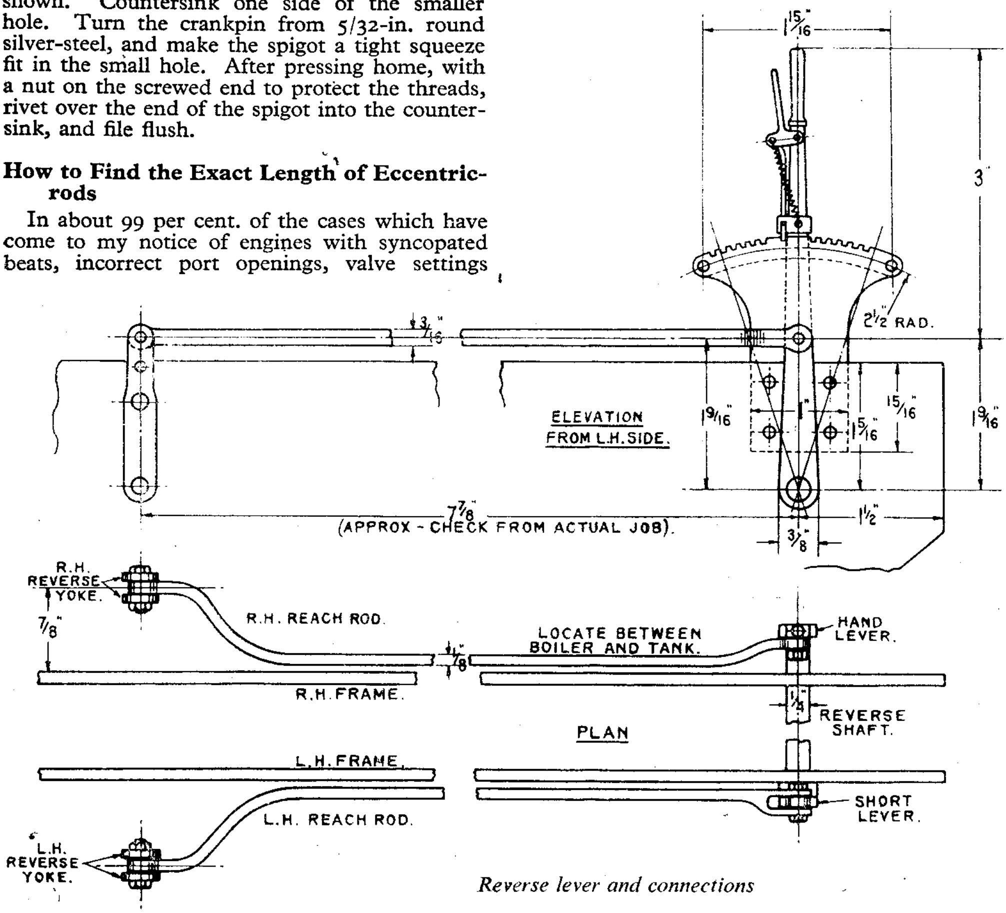
by "L.B.S.C."

Valve-Gear—Return Cranks and Eccentric-rods

WHILST the return crank of a Baker valve-gear is similar to that of a Walschaerts, readers will notice one difference, viz. that it is much longer. The bottom end of the gear connecting-rod has to swing in a much longer arc than the tail of a Walschaerts link, and the return crankpin has therefore to sweep a circle which very nearly equals the sweep of the main crankpin. That, however, makes no difference to the construction, and the illustration gives all dimensions of the simple job of filing—or milling—and drilling. I keep all my odd cuttings of frame steel for jobs like these. Drill the holes first, and file or mill to outline, as shown. Countersink one side of the smaller hole. Turn the crankpin from 5/32-in. round silver-steel, and make the spigot a tight squeeze fit in the small hole. After pressing home, with a nut on the screwed end to protect the threads, rivet over the end of the spigot into the countersink, and file flush.

How to Find the Exact Length of Eccentric-rods

In about 99 per cent. of the cases which have come to my notice of engines with syncopated beats, incorrect port openings, valve settings differing in forward and back gears, and other troubles of a like nature, the two principal causes have been eccentric-rods of wrong length, and return cranks not properly set. Yet it is *so easy* to get both exactly right! I explained this matter, with regard to Walschaerts gear, when describing how to build *Tich*; and it is just as simple, when dealing with Baker gear. All you need for the job, is just a pair of dividers, and the usual modicum of common sense; the former will probably be on your bench, and if you haven't

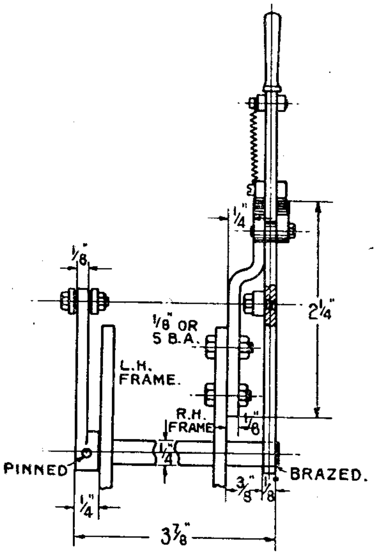


Reverse lever and connections

the latter—well, you wouldn't be building a *Juliet*!

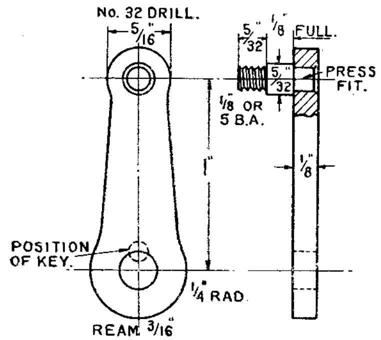
First of all, squeeze the return cranks on the spigots at the ends of the main crankpins, and set them " by eye," with the pins (as near as you can judge) at right-angles to the main crankpins, and in advance of them when the wheels are turned in the forward direction. The correct position is shown, both in the general arrangement drawing of the engine, and the side view of the complete valve-gear, published in previous instalments of this " serial." Then set the wheels, so that the main cranks are on the front dead centre, the return crankpins then being on bottom centre. Next, move the gear connecting-rod to such a position, that when the reverse yoke is moved back and forth, the bell crank, and consequently the valve spindle, does not move. This position is found in a few seconds, by trial and error, holding the gear connecting-rod with one hand, and waggling the reverse yoke with the other. Jam the " sickle " temporarily in that position, with a wooden wedge, or anything else you may have handy ; but make certain it can't accidentally shift, or you've had it.

Now take your dividers, and open them so that the points exactly match up with the middle



Back view of reversing gear

of the hole at the bottom of the gear connecting-rod, and the centre of the return crankpin. Having got that O.K., turn the wheels until the main crankpin is on the back dead centre, and the return crankpin on the top centre. Apply your dividers again, as above, without shifting the adjustment. If the measurements tally, you have no need for any alteration ; but if they don't, shift the return crank, so that the pin moves *half the difference* between the original setting of the dividers, and the setting needed to span between the pin and the gear connecting-rod hole in the new position. Then repeat the ceremony. When the distance between the centres of the return crankpin and the gear connecting-rod hole is *exactly the same* when measured with the dividers, with the main crankpin on either front or back dead centre, the return crankpin is correctly set, *and the distance between the divider points is the exact measurement of the eccentric-rod between centres of holes.* What could be easier ? Some folk would prefer to work it out with a slide-rule and a calculating



Return crank

machine, but I've never yet known the above simple method to fail, so personally I always set mine that way !

The return cranks can be kept from moving, by drilling a No. 43 hole in the boss, right on the line where the spigot of the main crankpin shows through, so that half of the hole is in the spigot, and the other half in the return crank. Drill to about $\frac{3}{16}$ in. depth, and squeeze in a bit of 3/32-in. round silver-steel, to form a key ; file off flush. Some builders tap the hole, and screw in a stub of steel ; but this prevents the return crank being taken off without what the kiddies would call " doing it in." With the smooth pressed-in key, the crank is easily removable, for such purposes as renewing the big-end bush ; and is replaced in correct position by merely lining up the two halves of the hole (says Pat) and squeezing in the key again.

The eccentric rods are shown in the accompanying illustration, and as they are made in the same way as valve rods, combination levers and other parts, no detailed instructions are required. They may be cut from solid bar, by milling, or sawing and filing ; alternatively, the straight part may be made from $\frac{3}{8}$ in. × $\frac{1}{8}$ in. flat steel, and a little block brazed on, to make the fork, as described for *Tich*. But the great and most important thing, is to be sure that the centres are *exactly* the same as indicated by the dividers, when the return cranks are set ; and each side must be done separately. The end that goes on the return crankpin may be reamed 5/32 in. and case-hardened, as described in the *Tich* notes (that coming *Tich* handbook is going to be mighty useful for reference, judging by correspondence !) or you can drill the eye 7/32 in. and fit a bronze bush in it, just as you fancy. The bush should be turned to a squeeze fit, and reamed 5/32 in. Don't forget the oil hole !

Erection of the eccentric-rods, is only a few minutes' job. Slip the eye end over the return crankpin, and secure with a nut and washer. Ordinary commercial nuts and washers will do, but the nut should be a good fit on the thread, so that it doesn't come adrift when the engine is travelling at a tidy lick, otherwise things may happen. The fork is attached to the bottom end of the gear connecting-tod by a little bolt made from 5/32-in. silver-steel, reduced at both ends to $\frac{1}{8}$ in. diameter, screwed $\frac{1}{8}$ in. or 5 B.A., and nutted. Note, there should be a full $\frac{5}{16}$ in. of "plain" between the shoulders, so that both nuts can be screwed up tightly against them, without pinching in the sides of the fork. The bolt should turn easily with finger pressure when both nuts are tight.

Reversing Gear

The gear is notched up and reversed by a "pole" lever, same as on the original *Juliet* fitted with link motion; but we can't use exactly the same layout, for the following reasons. Each set of link motion is operated by a lifting link suspended from the arms of a weighbar shaft connected to the cab lever; the reversing motion is up-and-down. As the reversing motion on the Baker gear is fore-and-aft, as our nautical friends would say, the weighbar shaft needs vertical arms, with push-and-pull connections. Actually, this simplifies matters a little, in the present instance, as we can easily set the weighbar shaft—or rather, the reversing shaft, as in this case it has no balance-weights—at the rear end of the engine, and mount the reversing lever direct on the end of it. The reversing lever can be connected by a long reach-rod, direct to the reverse yoke of the Baker gear on one side of the engine, cutting out any intermediate push-and-pull connection; a shorter vertical arm on the other end of the shaft, is connected in like manner to the other set of gear, and both operate in unison when the lever is moved. The whole bag of tricks is clearly shown in the accompanying illustrations.

Lever and Stand

Full instructions for making a reversing lever and stand, were given in the original *Juliet* notes, also for *Tich*; and as this one is made in a manner somewhat similar to those, we needn't repeat the whole ritual. I'll just call attention to the differences. The lever itself—it reminds one of a famous poet (Longfellow!) can be made from $\frac{3}{8}$ in. × $\frac{1}{8}$ in. steel, with a turned handle or grip brazed on; the trigger, latch, and latch-block are the same as those on the original *Juliet*, but the latch has a longer rod, as shown. The stand is sawn and filed from $\frac{1}{8}$-in. steel plate; any suitable bit of left-over frame steel does fine. It is set over $\frac{1}{4}$ in. just below the curved top, as shown; in that position, the lever will clear the boiler, to the same amount as it did on *Juliet* I. The retaining plate, or quadrant, which keeps the lever in position, can be bent to the given curve from a piece of $\frac{1}{8}$ in. × $\frac{3}{16}$ in. steel, or sawn and filed from the flat; more use for the odd bits of frame steel—hoots, mon, awa' wi' ye! It is attached to the stand by 8-B.A. screws, with spacers $\frac{3}{16}$ in. diameter and a full $\frac{1}{8}$ in. thick, put between. The complete stand is attached to the main frame by four $\frac{1}{8}$-in. or 5-B.A. bolts, as shown; the centre-line of it is $1\frac{1}{2}$ in. from the back end of frame, and the bottom edge $\frac{15}{16}$ in. below the top line of frame.

Note: as shown, the lever is arranged for a right-hand-drive engine; but as the left side is now the driving side on all new engines (the L.B. & S.C.R. engines were left-hand drive, also the L. & N.W.R.) builders may prefer to change over. All you have to do, is to erect the stand on the left, and put the short lever on the right.

Reverse Shaft and Connections

On each side of the frame, at $1\frac{5}{16}$ in. from the top, and $1\frac{1}{2}$ in. from the back edge, drill a No. 30 hole, and poke a bit of $\frac{1}{8}$-in. round silver-steel through, to make sure they are both in line. If so, open them out with 15/64-in. or letter C drill, and poke a $\frac{1}{4}$-in. parallel reamer through. If not, correct with a file, and try with 5/32-in. drill, testing with a bit of 5/32-in. rod. It isn't necessary to bush these holes, as the wear is infinitesimal; but relations of Inspector Meticulous can bush them if their consciences won't allow them to do otherwise. Cut a piece of $\frac{1}{4}$-in. round steel (mild or silver, doesn't matter much which) to a bare 4 in. long, and square off the ends in the lathe, to a full $3\frac{7}{8}$ in. Braze or silver-solder the hand lever to one end of it; clean up, then take the quadrant plate off the lever stand, insert shaft through holes in frame until the lever touches the stand, and replace the quadrant plate. Don't file any notches yet.

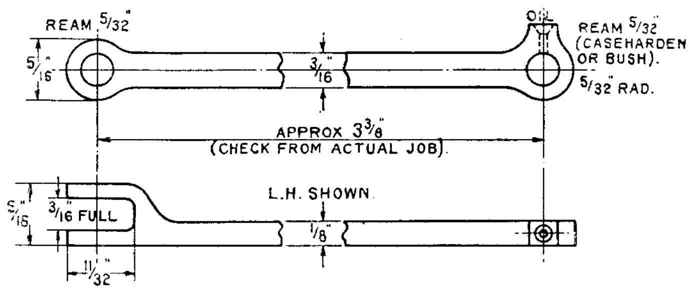
The short lever is filed up from $\frac{3}{8}$-in. × $\frac{1}{8}$-in. steel, and has a boss $\frac{3}{8}$ in. diameter and $\frac{1}{4}$ in. wide at the bottom. How to fit and braze these bosses was another one of the items fully expounded in the *Tich* serial. Chuck the projecting bit of boss in three-jaw, centre, drill 15/64 in. or letter C, and ream $\frac{1}{4}$ in., but don't put the reamer too far through, as the boss should be a tight fit on the shaft. Squeeze it on, so that the lever is free to move back and forth, but the shaft has no endplay. Set it so that both short lever and hand lever are parallel.

Reach-Rods or Reversing-Rods

The reach-rods are made from $\frac{1}{4}$-in. × $\frac{1}{8}$-in. steel. As they have to be set in towards the frame, to enable them to pass between the side tanks and the boiler, the best way to get the exact lengths, is to make a template from a bit of thin metal which can easily be bent by finger pressure. Any thin strip stuff will do. We sometimes receive parcels from U.S.A. which are fastened with thin metal bands, which look like spring steel, but are quite soft; I use them for jobs such as above.

The first item is to set the reverse yoke in mid-gear. This is easily done by resting the buffer beams of the engine on two blocks, so that the wheels clear the bench. Turn the wheels by hand, and move the reverse yoke towards middle. When the bell-crank and the valve-rod remain stationary, whilst the wheels are being turned, the reverse yoke is exactly in mid-gear; temporarily fix it there. Now put the reverse lever dead in the middle of its travel; you can do that

by measurement. Now bend your bit of strip, to the shape shown in the plan of the reversing connections. Poke the point of a scriber through the holes in the reverse yoke and the reversing lever, marking the strip, and drill $\frac{1}{8}$-in. holes at these points. Replace strip, and check to see if whilst the wheels are turned with the lever in the middle, the short lever is in the correct position on the shaft, and can be pinned to it by drilling a No. 43 hole through boss and shaft, and forcing in a pin made from 3/32-in. silver-steel. File the mid-gear notch in the quadrant,



Eccentric-rod

the holes line up with those in the yoke and lever. If they do, straighten out the bit of strip, and cut your $\frac{1}{4}$-in. $\times$ $\frac{1}{8}$-in. steel to same length, rounding the ends, and drilling the holes as indicated by the template. Then bend the steel to the same contour as the template was bent, and couple up. The lever end is attached by a shouldered set-screw turned from $\frac{1}{4}$-in. hexagon rod, as shown in the section of lever. The front end passes between the two halves of the reverse yoke, and is attached by a bolt, made in the same way as the bolt at the bottom of the gear connecting-rod.

Get the length of the other reach-rod by using a template, as described above, and transfer the measurements to the steel likewise ; but instead of using a shouldered set-screw to attach the end of the rod to the short lever, braze a small block of steel on the back end of the rod, and machine it into a fork, as described for making up valve-gear forks ; see illustration. Use bolts for attaching both ends of this rod. Then make the final check-up. Put the hand lever in mid-position, turn the wheels, and see that the valve rod and bell-crank remain stationary. The other side should be the same. If the bell-crank moves, shift the short lever slightly, back or forward, as the case may be, until the movement stops. When the valve-rods both keep still, with the lever in this position. Push the lever forward until the reverse yoke touches the bell-crank bush, then pull it back a shade until the yoke clears the bush by a bare $\frac{1}{16}$ in. That is your full fore-gear position, so file a notch for the latch. Note how far the lever is ahead of centre ; then pull it back, so that it is exactly the same distance behind centre. That gives you your full back-gear position ; file the notch at the spot where the latch rests. The intermediate notches can then be filed as shown in the illustration.

How to Set the Valves

Valve-setting with the above arrangement is the simplest job you ever did. Take off the steam-chest covers ; put the reverse lever in mid-position ; turn the wheels by hand and adjust each valve on its spindle until the edge of the port shows as a thin black line against the lap of the valve, at each end of its movement. The adjustment is made by taking the bolt out of the valve fork, and turning it. The above is all you need worry about ; the valve gear itself will take care of the port opening, exhaust release, and all the rest of it. Replace the steam-chest covers, putting jointing gaskets under them, and Bob's your uncle, as far as the cylinders and valve gear are concerned.

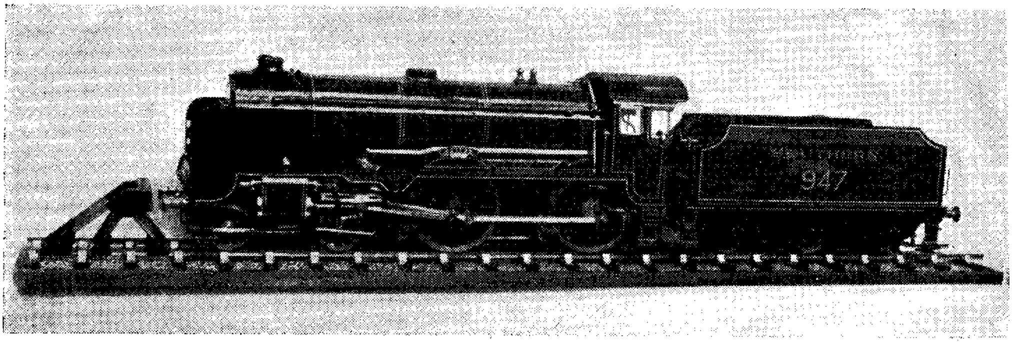
For the Bookshelf

Motor Cycle Engines, by the Staff of *The Motor Cycle.* Iliffe & Sons Ltd. Price 3s. 6d.

Here is a book that will appeal to a great many of our readers—a comprehensive analysis of a number of well-known British power units by some of the best informed technical experts in the journalistic field of motor cycling.

Regular readers of *The Motor Cycle* will remember the popular " Modern Engine Series." This volume has been compiled from a first selection of these articles, and is profusely illustrated, as were the original articles, by exploded and sectioned drawings of great technical merit. On a page size of $10\frac{1}{2}$ in. $\times$ $8\frac{1}{4}$ in. approx., none of the original clarity is lost and the accompanying text is of absorbing interest throughout.

A wealth of information for the i.c. engine enthusiast at a most meagre cost !



Photograph No. 1. Mr. J. Bennett's "Schools" class locomotive won two trophies at the Northern Exhibition. The engine is 45 in. long over the buffers

LOCOMOTIVES AT THE NORTHERN MODELS EXHIBITION

by "Northerner"

(*Photographs by the author*)

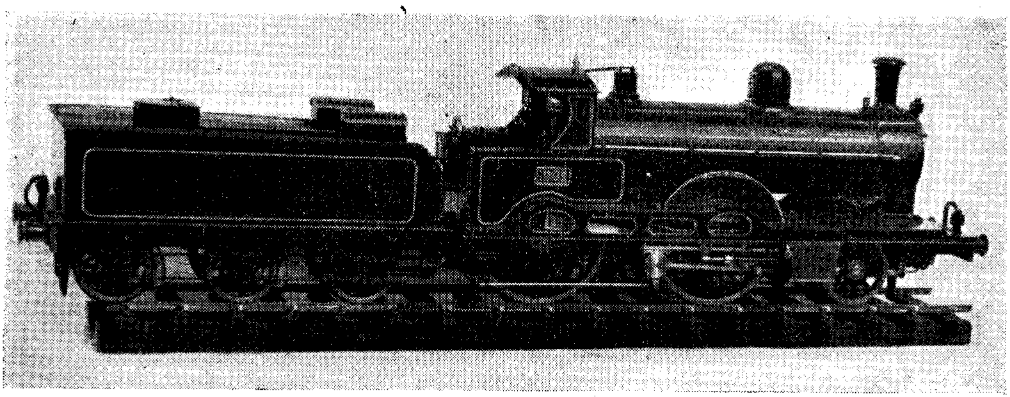
THERE were several fine passenger-hauling locomotives in the N.A.M.E. Exhibition at Manchester, but the one which rightly won the N.A.M.E. Members' Trophy and the *Evening Chronicle* Loco. Models Trophy was Mr. J. Bennett's "Schools" Class locomotive to 1-in. scale.

This engine was well finished both in the machining and the paintwork, and the detail was also well carried out. For example, tiny castle-nuts were fitted on brake-gear and other parts, and the footplates were correctly chequered, with the "lines" of the diamonds raised, and the "diamonds" themselves sunk. This effect was obtained by ruling lines in melted wax on the plates, and applying acid to the surface. Naturally, the surface was etched away between the lines, leaving the lines raised. However, Mr. Bennett told me that he had rather rushed this job to complete the engine for the show; he was not entirely satisfied with the result, and intends to make new plates in replacement.

Original Features

There were one or two original features about the engine which appealed to me, and which might well be used by other builders. One of these was that although the working whistle is concealed, being grossly oversize, as usual, a puff of steam issues from the *dummy* whistle, mounted on the cab-front, when the real whistle is blown. As Mr. Bennett said, this doesn't take a lot of wangling, but it does add greatly to the realism.

Another point is that a small plunger-type oil-pump is fitted in the cab. When this is operated, by hand, oil is fed positively to the



Photograph No. 2. "Jeanie Deans," a Webb compound built by Mr. E. E. Hobson, had truly captured the appearance and spirit of the prototype

main axleboxes and other points inside the frames which are difficult to reach otherwise.

Working leaf-springs are fitted, with two leaves to each plate to give the required flexibility with scale appearance. The steam brakes also work.

The engine is the result of four years' spare-time work, and although the performance has not yet been fully tested, she steams well. As already mentioned, the paintwork is excellent. It is in correct Southern green, which was very kindly supplied by the appropriate region of British Railways, and the painting and lining were done by the builder himself. However, he did not feel too confident over the lettering question, and so had this done professionally.

The nameplates, by the way, were made by mounting brass sheet on the faceplate, and milling out a shallow channel section at the appropriate radius. This gave the curved plates, with upper and lower mouldings. The letters are brass pattern-makers' letters soldered on ; the end-mouldings were added, and the result is two very neat nameplates.

Workshop Equipment

In his workshop Mr. Bennett has a Myford "M"-type lathe, and a No. 2 Adept shaper. A home-made sensitive drill completes the list of machine-tools, and there are, of course, the usual hand-tools.

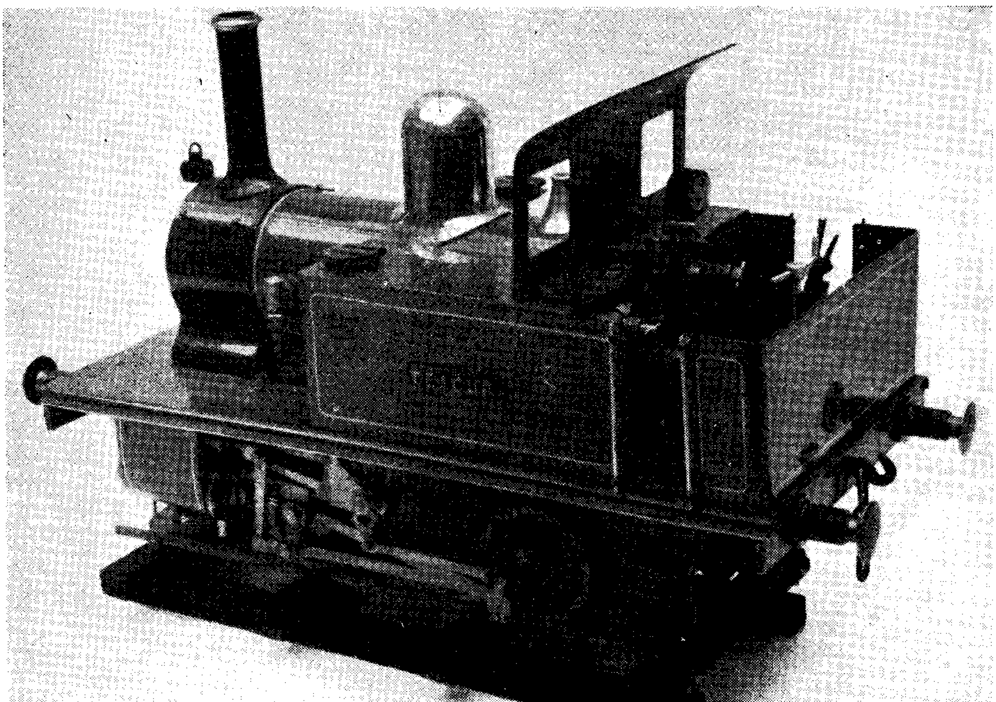
This is Mr. Bennett's fifth locomotive, the others being all to 2½-in. gauge, and comprising "L.B.S.C.'s" *Annie Boddie* an L.M.S. 2-6-4 "Stanier" tank engine, a Claughton enlarged-boiler type locomotive, and a Great Northern "single."

"Jeanie Deans"

In the space available, there is not room to describe other exhibits at length, but I must mention an engine which I am sure would have appealed to "L.B.S.C." This was a very neat and well-finished model of the L.N.W.R. Webb compound *Jeanie Deans* In her gleaming black coat, this engine looked every inch an aristocrat, and her builder, Mr. E. E. Hobson, of Chester, can be proud of having captured the spirit of the prototype.

An 0-4-0 Shunting Locomotive

Another exhibit which appealed to me was *Teacup* a 5-in. gauge locomotive by Mr. J. W. Mercer. Nicely finished, this engine represented a contractor's type 0-4-0 of the 1880's period. Being to 1-in. scale, and with only small wheels, she should have plenty of power on the track, and her open footplate will allow of easy control. Moreover, since there is no tender to stretch over, the controls will be almost in the driver's lap, so to speak!

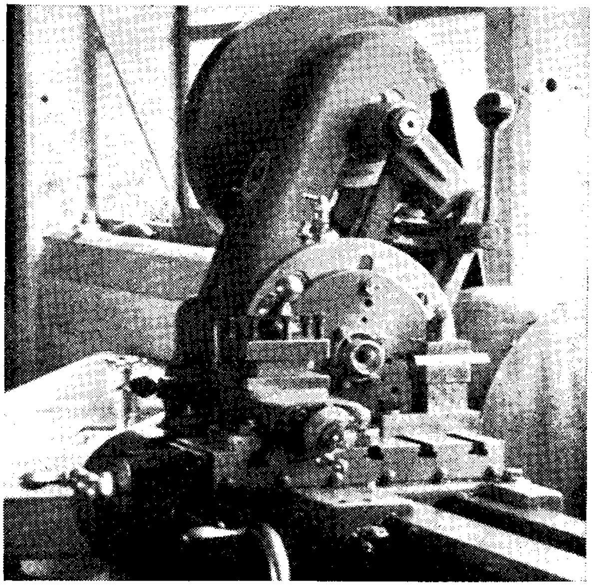


Photograph No. 3. An excellent model of a contractor's locomotive, built by Mr. J. W. Mercer, of Newton-le-Willows

Model Engineering After School

by H. W. Green

(Handicrafts Master)

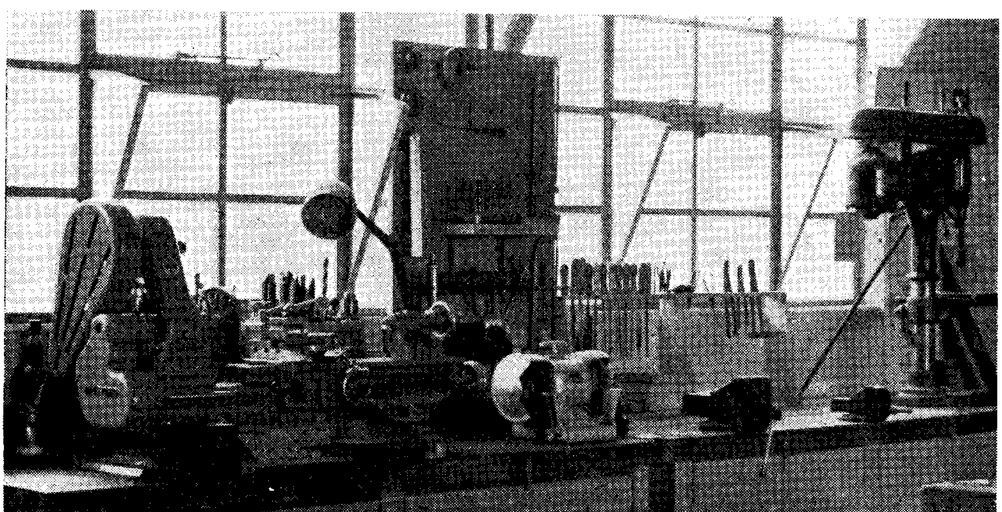


Ready for machining a ball-race housing

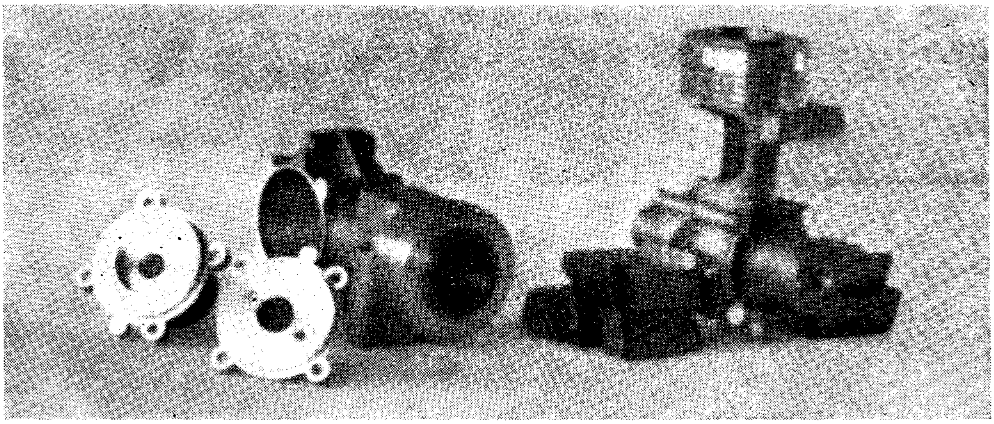
I HAVE been interested in the two recent articles in THE MODEL ENGINEER on model engineering in schools, so much so, that I am giving here some details of, the activities at the King Edward VI School, Nuneaton.

The handicraft department of this school is primarily concerned with preparing boys for the G.C.E. examination in woodwork. However, we do quite a lot of work in the workshop out of school hours, and most of it is done by the Model Engineer Club, which meets two days a week immediately after school. This club has only been in existence since last September, but there is great keenness and enthusiasm amongst its members, and a high standard of work is maintained. Quite a variety of work is being attempted, from single-action oscillating steam engines to wireless sets ! The most popular form of modelling, however, is model cars, and two or three models are under construction, the most ambitious being a model of the B.R.M. to be powered by a 10 c.c. engine. The boys have constructed their own pylon for car racing and this is erected in the school playground when required. We are very fortunate in having the help and advice of Mr. Gerald Smith, the well-known designer of i.c. racing engines. Two of Mr. Smith's 10 c.c. engines are being constructed from his own jigs and castings.

One of the photographs shows how the model engineering bench is arranged on one side of the workshop, and, although we are a little short of



The school work bench



Model petrol engines under construction in the school

space, work proceeds quite smoothly. The M.L.7 lathe was delivered last August and the equipment shown has been built up during the ensuing months. The subscription of 3d. a week from members is a great help in providing small tools like reamers, end-mills, etc. The close-up shot of the lathe shows a crankcase end-plate set up on a faceplate jig for the machining of the front ball-race housing, whilst the other photograph shows the two 10 c.c. engines under construction.

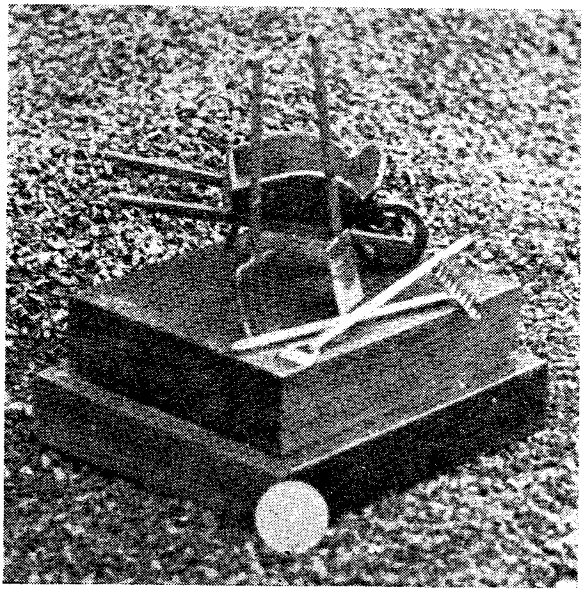
Models as Trophies

I HAVE been a reader of THE MODEL ENGINEER for many years, and am grateful for the instruction and pleasure it has given me. I am not a "Live Steamer," nor do I, in fact, pursue any particular line covered by the pages, but I read it all with avidity.

Some time ago I was asked to give a trophy, to be awarded in a horticultural show which was being organised. Now, I have always felt that a trophy should tell a story of its own; that it should, in fact, be designed for its intended purpose, and not be a mere "pot" with no special significance.

After much cogitation — and browsing through back numbers of THE MODEL ENGINEER—a design was decided upon.

For ethical reasons an endeavour was made to be strictly "traditional" in the matter of materials. The metal work, therefore, is in mild-steel, and the parts are correctly formed, ferrules hammered to shape and riveted to the shafts. The tines of the rake are separately inserted and riveted. The "timber" is ash for the tool handles, mortised and tenoned where necessary. The barrow is in elm, correctly framed, and has an iron-tyred wheel. The block is built up of two pieces of elm, and the top surface is beautifully figured. It is polished without stain.



The photograph, taken on a heap of roadside chippings, with a "half-crown" for comparison, is by Mr. J. Dayes, of Haverfordwest, Pembrokeshire, to whom I am indebted—HARRY G. GAMMON.

A Model Vertical Engine and Boiler

by George H. Wallis

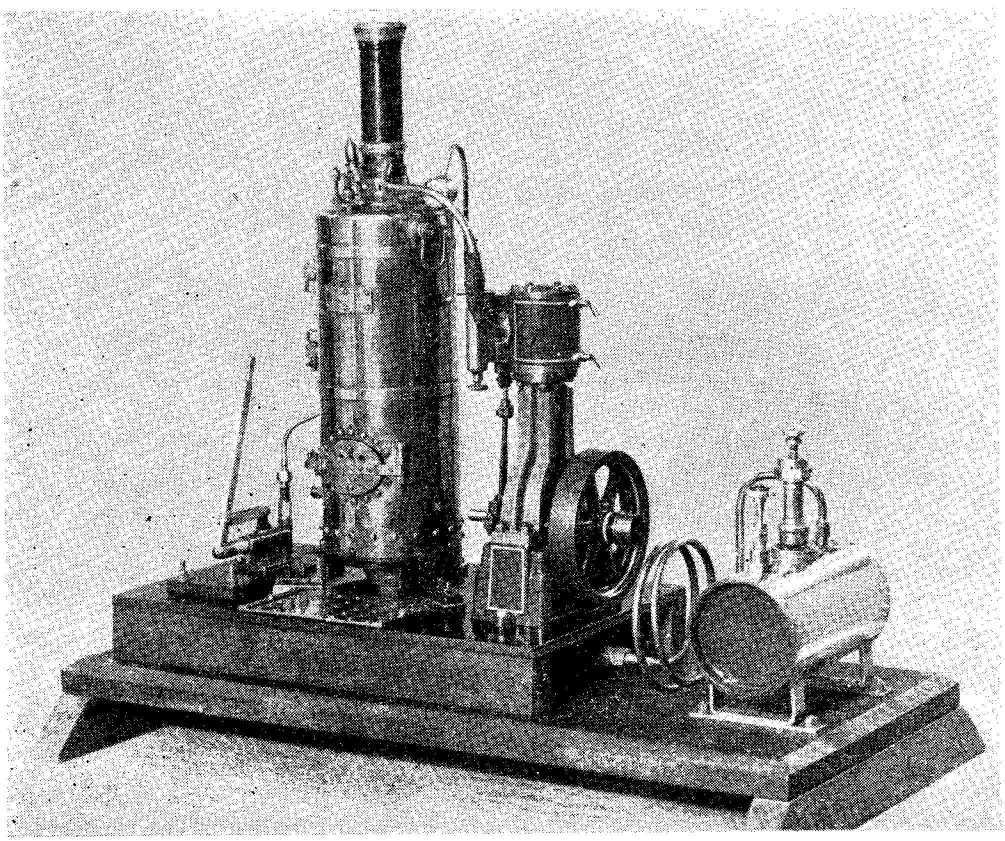
THIS model, which I have just completed, may be of interest to some readers. I am in the cycle business and after reading about the many fine models illustrated and described in THE MODEL ENGINEER, I decided to try my own hand at making a model. This is my first model and is largely designed and constructed from whatever suitable materials I could find in my workshop.

The boiler was first made from a piece of copper tube, $8\frac{1}{4}$ in. long by $3\frac{1}{4}$ in. dia. A firebox is made of brass $3\frac{1}{2}$ in. high by $2\frac{3}{4}$ in. dia. A brass flue-tube 1 in. dia. passes through the boiler from the firebox to the funnel. The base and furnace door were next turned in the lathe where necessary and carefully fitted. The contacting surfaces were then tinned with solder and holes drilled for $\frac{1}{8}$-in. rivets. Gunmetal mountings for the boiler fittings were next fitted, tinned and drilled for $\frac{1}{16}$ in. rivets. The whole was then assembled, riveted up and sweated with a blowlamp. The fittings on the boiler consist of a water gauge, steam gauge, safety-valve, whistle and draining cock.

The engine I did not construct myself. It had been a well-made model from iron castings of 1 in. bore by $1\frac{1}{4}$ in. stroke, but was incomplete and in bad condition when I acquired it. Broken studs had to be removed and new ones fitted, also a new wheel valve and drain cocks. The old paint was burnt off with a small blowlamp, re-enamelled in brown and blue and stoved in my electric cooker. It was then lined with yellow enamel as a finishing touch.

The force pump is made up from brass castings. The boiler, engine and force pump are mounted on a dark red plastic baseboard measuring $11\frac{1}{2}$ in. by $7\frac{1}{2}$ in.

The fuel tank is of brass mounted on a separate wooden baseboard measuring 19 in. by 9 in. and supplies a No. 4 Primus burner which is up in the firebox, when the boiler and engine on their base is placed in position. The fuel tank is 5 in. long by $2\frac{3}{4}$ in. dia. Ends are riveted on and fitted with pump and valves, as in a Primus stove. The tank holds sufficient fuel to keep the engine going for about three ahd a half hours. An occasional use of the force pump keeps the water in the boiler water gauge up to a reasonable level.



"Talking about Steam——"

by W. J. Hughes

A series of articles intended to supply suggestions and information for the would-be "modeller in steam" who has not the time, the inclination or the opportunity for extensive research

5: *Small and Medium-sized Stationary Engines

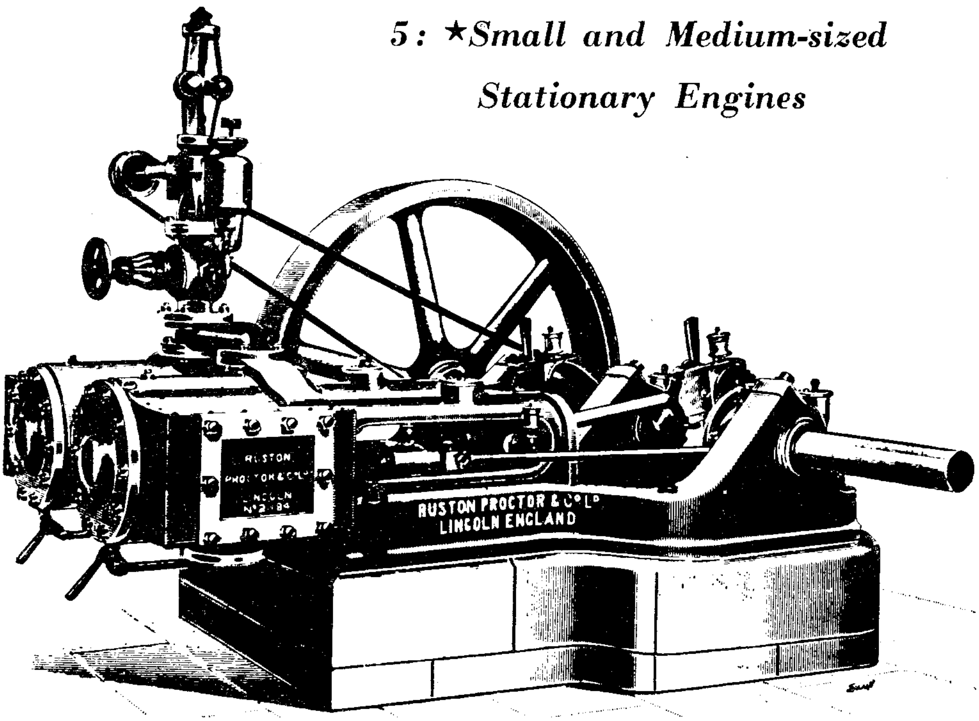


Fig. 15. Double-cylinder engine with simple expansion and ordinary slide-valves. Note centre bearing between cranks. (Courtesy Messrs. Ruston-Hornsby & Co. Ltd.)

FOR those who would like a little more complication than the single-cylinder engines described in the last article of this series, what about a double-cylinder engine? Figs. 15, 16 and 18 show three variations of an engine of Ruston, Proctor's Class XX.

In each illustration the main parts are the same, but different types of valve-gear are fitted.

In Fig. 15, the "normal" type of slide-valve is fitted to each cylinder, with a single eccentric driving each valve-rod. The cut-off is, therefore, unvariable, except by altering the position of the eccentric relative to its driving-disc, as described earlier. Governing is by a Pickering-type governor, as illustrated.

In the engine shown in Fig. 16, however, "Rider" type automatic expansion valve-gear is fitted. This will be described and illustrated in a subsequent article, when we discuss different expansion gears, but for the present a brief explanation will not be out of place.

There are two eccentrics to each cylinder, and two slide-valves, one of which works on the back of the other. The innermost valve is concave on its back, and the outer one, the expansion valve, is convex to fit into it. (See Fig. 17.)

Sloping ports, inclined towards each other,

*Continued from page 581, "M.E.," May 1, 1952.

are cut in the innermost valve, but the passages are "twisted," so to speak, so that when they reach the valve-face the ports are vertical. The innermost edges of these ports correspond with the outer edges of a normal slide-valve, and the exhaust cavity is cast between them in the normal way. This valve, then, would work quite normally without any additions.

However, sliding on its back, and driven by the second eccentric, is the expansion valve, which has its outer edges cut at the same angles as the ports in the inner valve. Its reciprocating movement is so timed that it closes the inlet ports to give the correct cut-off for the normal load on the engine.

But it should be obvious that if the expansion valve is *rotated* about its axis, in an upwards direction, it will close the inlet ports earlier in the stroke, and so cut off the steam earlier—that is, allow more expansion. Hence the name "automatic expansion valve-gear," since this rotatory movement of the expansion valve is controlled by the governor, which rotates the valve-rod as required by means of links.

In the case of the double-cylinder engine illustrated, the governor controls the expansion valve of each cylinder, of course, and the rod between the governor and the far valve may be seen passing through the side-opening in the trunk-guides.

Link Motion

Fig. 18 shows the same class of engine fitted with Stephenson link-motion reversing-gear—not very common, since most factories required engines to run one way only, but some readers may fancy it. Notice that the brackets carrying the weighbar shaft and lifting links are simply bolted to the tops of the trunk-guides. No governor is fitted, of course, because expansion is controlled by the position of the links.

As has been said, these three engines are basically identical. The class was built by Ruston, Proctor with cylinders from 9½ in. bore by 14 in. stroke up to 14 in. by 18 in. The cranks are at 90 deg. to each other, in the normal

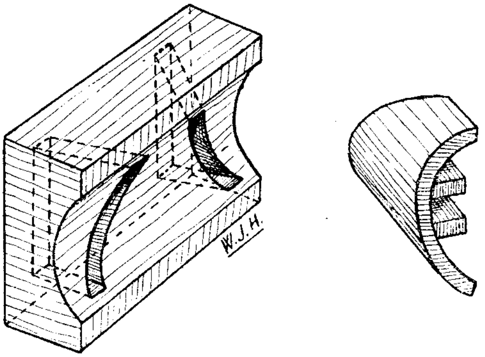


Fig. 17. Sketch to show, diagrammatically, how the Rider valve-gear works. Exhaust cavity omitted for clearness

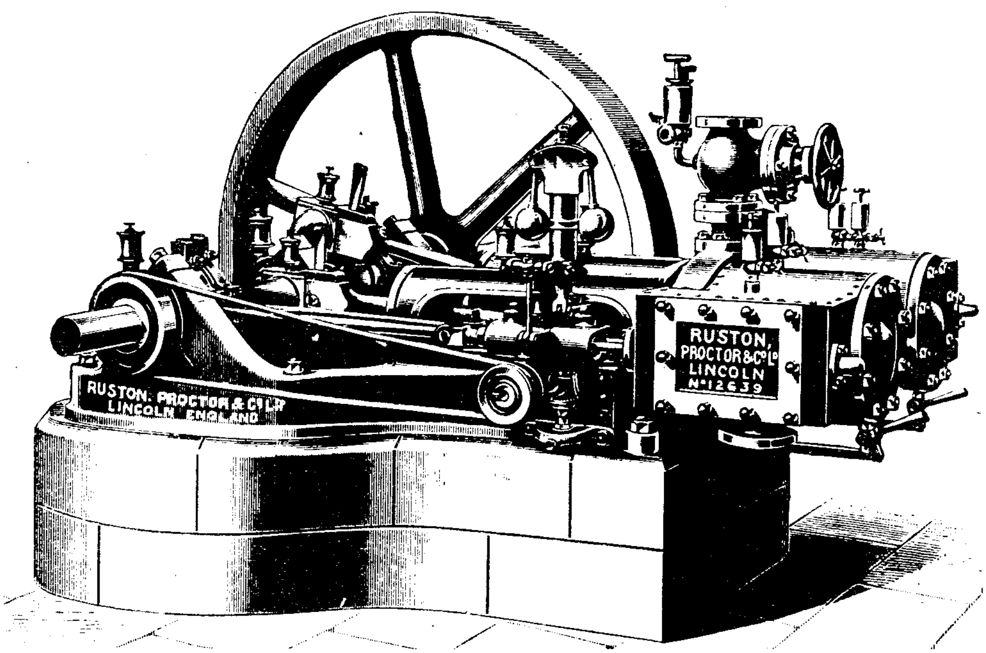


Fig. 16. A similar engine to that shown in Fig. 15, but fitted with Rider-type automatic expansion valve-gear for extra economy. (Courtesy Messrs. Ruston-Hornsby & Co. Ltd.)

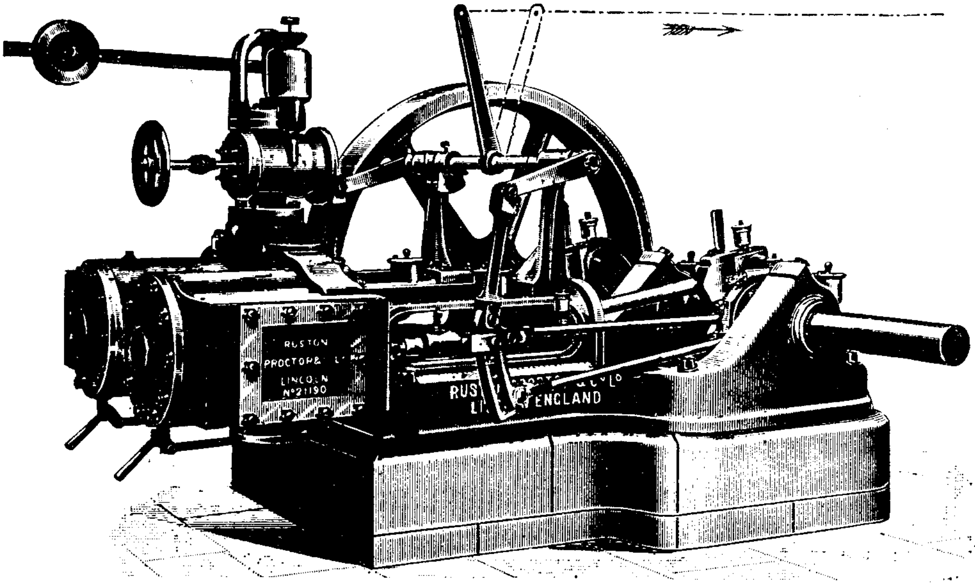


Fig. 18. *A double-cylinder engine fitted with Stephenson link-motion reversing gear : reach-rod and reversing lever not shown.* (*Courtesy Messrs. Ruston-Hornsby & Co. Ltd.*)

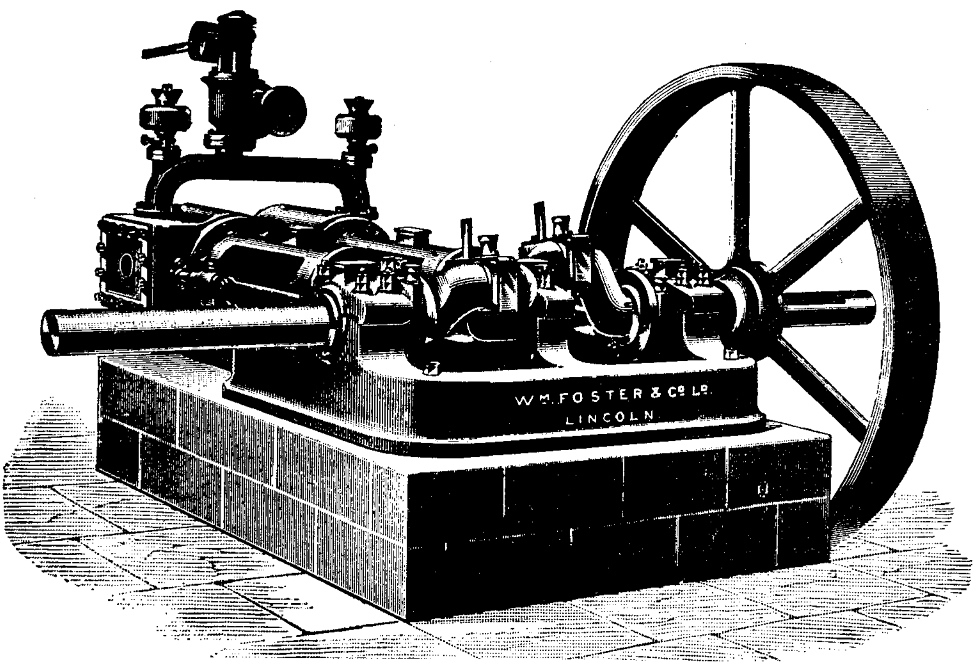


Fig. 19. *A Foster double-cylinder horizontal engine, with crankshaft carried in three bearings.* (*Courtesy Messrs. Wm. Foster & Co. Ltd.*)

practice, and the crankshaft is carried in three bearings. Otherwise the general details are very similar to those of the single-cylinder engines described in the last article.

Different Details

I am also including two illustrations from a catalogue of 1895, issued by Messrs. William Foster & Co. Ltd., another well-known Lincoln engines offered by the trade suffer from this defect, and I would urge any reader who is building, or intends to build, from a commercial design, to keep this in mind. It is not a difficult matter to use eight or ten studs instead of six, to secure the cylinder covers, for instance, but the model may well gain immeasurably thereby in its appearance.

The same remarks apply to other frequently

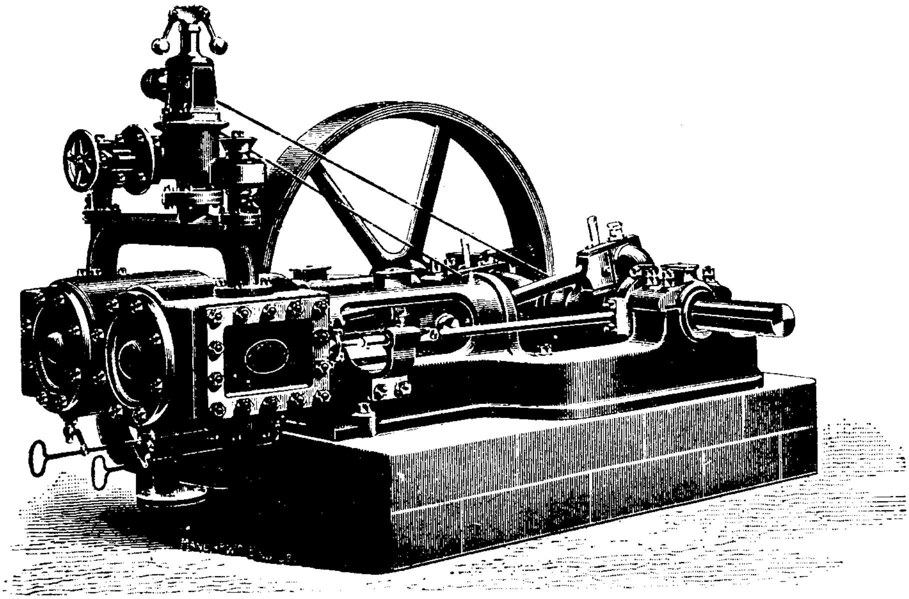


Fig. 20. A similar engine, but of lighter pattern, with central bearing omitted. Note exhaust pipes connected to single branch

firm. Although essentially very similar to the former examples, such details as main-bearings, lubricators, valve-slide brackets, and so on, are different, and should be noted if realism is required.

It is in such items that many model steam-engines fall down, incidentally. A fault which is much too common is not to use enough studs and nuts to secure the covers for the cylinders and valve-chests, and this fault automatically gives rise to another one: namely, that the studs and nuts used are too big in proportion to the size of the model. The latter error is all too prevalent in other places, too, but that is by the way. Note that in the Ruston, Proctor engines there are ten studs to the valve-chests and eight or ten to the cylinder-covers, while on the Foster engines there are no fewer than fourteen to the valve-covers, with eight to the cylinder-covers. And remember that these are only small engines!

Don't Overdo the "Massive" Idea!

Unfortunately, many of the designs of model oversize details, such as oil-cups, cylinder drain-cocks, too-thick connecting-rods and valve-rods, too massive knuckle-joints and so on. So many model engineers seem afraid to *trust* the correct proportions, and although it is agreed that sometimes it is highly desirable to "strengthen" some part or parts, this is rarely necessary on external detail.

After all, taking the commonsense point of view, how much actual *work* does the average model steam engine do, as compared with its prototype? Even if it has to earn its living—as, for example, a model marine engine installed in a boat—it will not usually run more than a few hours a week, on the average. Whereas the full-sized job has to go on plugging away, day and night, for days and days on end.

Surely, then, the model engineer can afford to let his proportions be correct, and not to overdo the "massive" idea! The hallmark of a good model is *realism*, and that cannot be achieved without due attention to detail and scale appearance.

(To be continued)

IN THE WORKSHOP

by "Duplex"

No. 116.—*Fitting an Electric Motor to the Tailstock Drilling Spindle

THE dust cover itself is provided with two holes for the plastic terminals that secure the brushes in place. These holes are best made by means of the simple sheet-metal piercing device described and illustrated in "Novices' Corner" on November 22nd, 1951, the article being entitled "Cutting Holes in Sheet Metal." This device is in reality a miniature punching bar operated by means of a draw-nut threaded on a central stud mounted in a base-piece. The central stud serves to guide a circular punch in the correct relation to a die affixed to the base-piece.

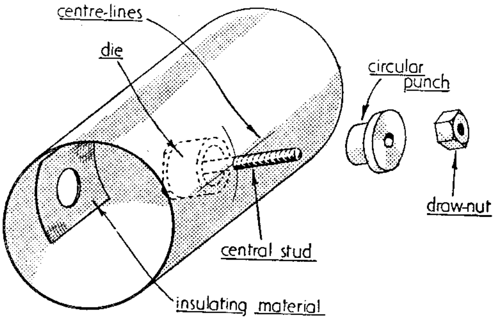


Fig. 7. Using the simple punching device to pierce holes in the dust cover for the motor brushes

In order to use the device, pilot holes to accommodate the threaded stud are first drilled in the work and the tool is assembled as seen in the illustration, Fig. 7.

Before the pilot holes can be drilled, the distance from the driving end-plate of the centres for the two motor brush terminals must be carefully determined. This dimension is transferred to the work by means of a surface gauge, with the tin cover mounted on end upon the surface plate. The work is then set on V-blocks and the cross centre-lines are scribed on the work, using methods that are familiar to many readers. Those who are not conversant with these methods should consult *Marking Out Practice for Mechanics*, published by Percival Marshall &

*Continued from page 642, "M.E.," May 15, 1952.

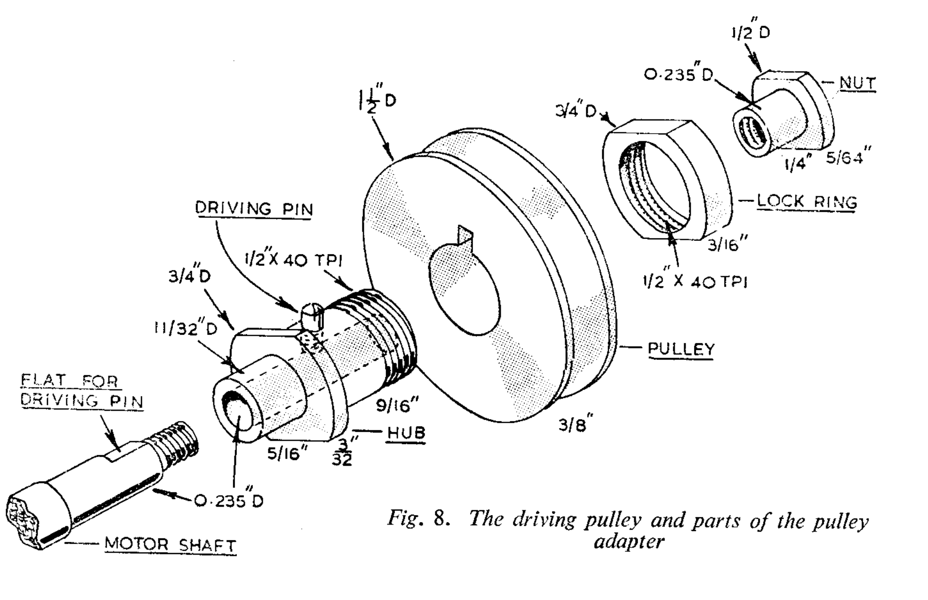


Fig. 8. The driving pulley and parts of the pulley adapter

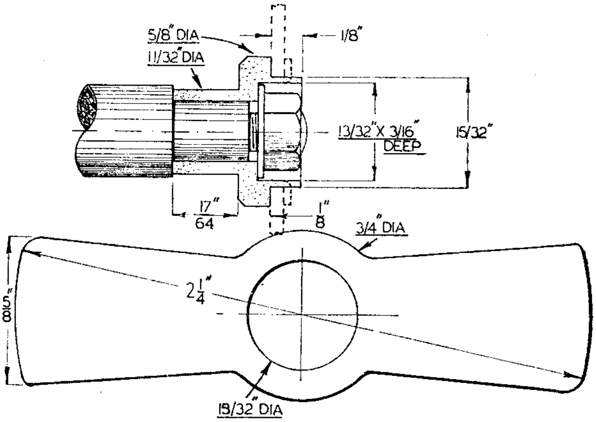


Fig. 9. Details of the fan mounting

Co. Ltd., for full information on this subject. When the holes have been punched correctly, strips of thin insulating material are fixed around the holes. This is important, for on some motors the terminals for the brushes also serve to secure the electrical leads. These leads would be dangerously close to the dust cover unless some insulating protection was provided. Empire cloth is quite suitable for the purpose and may be affixed either with Bostik or by means of paint that has been allowed to become tacky before the insulating cloth is applied.

The Driving Pulley and its Adapter

Details of the driving pulley and the pulley adapter are given in the illustration, Fig. 8. The pulley itself is machined from a piece of light alloy and is provided with a groove having an included angle of 30 deg. The belt employed is made from plastic material and is 5/32 in. dia. Small belts made from plastic material appear to be satisfactory, but experiments carried out with larger belts having diameters from $\frac{3}{16}$ in. and upwards suggest that much research is needed before a plastic is produced that will supplant leather belting.

The hub is machined from mild-steel, and is fitted with a brass driving pin that engages a flat formed on the shaft of the motor itself. The pin also engages the keyway in the pulley. In this way pulleys of varying sizes may be quickly fitted and held firmly in place by means of the lock-ring seen in the illustration. It will be observed that, in order to simplify the securing of the pulley, spanner flats are filed on the hub as well as upon the lock-ring.

The nut seen at the top of the illustration fits into the bore of the hub and serves to hold the component against a shoulder machined on the motor shaft itself. As will be seen, the diameter of this shaft is 0.235 in. In all probability this dimension was originally 0.250 in., but the particular motor that has been used suffered some maltreatment before it came into our possession, and the spindle needed remachining to render it parallel once more.

The fitting of the pulley has been described in some detail; for the method employed can equally well be applied to other small motors used for driving workshop equipment or other machines requiring a limited amount of power.

The Fan

The fan is not an essential accessory, for the duty that the motor is called upon to perform does not involve spells of continuous running. Nevertheless, if the motor is provided with a shaft extension at the commutator end of the machine it is well to fit a simple fan, for this will keep the motor cool under all normal conditions of use.

As will be seen in the illustration, Fig. 9, the fan itself is made from a piece of 20-gauge sheet iron or tin, and is secured to the hub adapter by riveting over the spigot that forms the seat for the fan. In order to secure the fan in place for riveting, a $\frac{9}{16}$ in. dia. steel ball is first placed in the mouth of the 13/32 in. dia. recess and the work is then put in the vice so that the squeezing action resulting from the closing of the vice jaws will cause the rim of the recess to expand and grip the fan. The work must, of course, be protected by means of brass clams interposed between the components and the jaws of the vice. If this is not done the hub will be damaged.

After the fan has been secured in the manner described above, the work is placed on the anvil and the rim is finally riveted over by means of a hammer. The finished appearance of the fan unit will be improved if the work is subsequently put in the lathe chuck and the rim is machined lightly to remove all hammer marks.

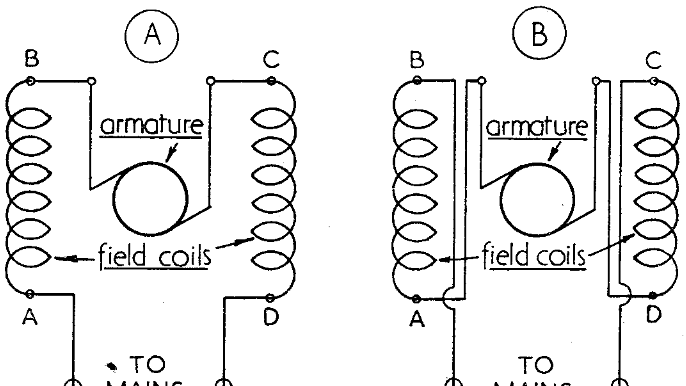


Fig. 10. Diagram of connections to show method of reversing a series-wound motor

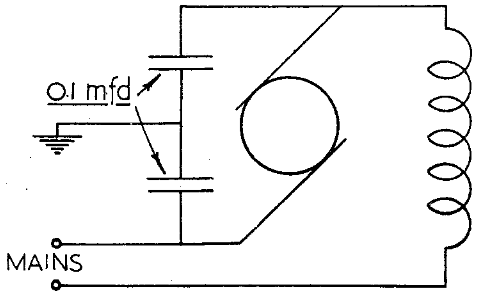


Fig. 11. *A simple method of suppressing interference with radio reception*

Electrical Connections

A small terminal block, mounted on the steel cross member seen in the illustration, Fig. 6, is provided for connecting the motor to the mains and the details of this component can be seen in the same drawing. It will be observed that hexagon screws are fitted ; these enable a small spanner to be used, since the lôcation of the terminal block does not allow a screwdriver to be employed.

As will be seen, the earth connection from the mains power plug is taken to a tag secured by the nut behind the cross member. If the lathe or machine with which the motor is to be used is itself properly earthed, a separate earth wire to the motor is not strictly essential. Nevertheless, the fitting of an earth wire is to be recommended as a protection in the event of the machine being used with equipment that is not earthed.

The electrical connections inside the motor itself are simple, for the machine is series-wound, that is to say that the armature or rotor is connected in series, with the field coils or stator. In practice, and the motor now being described is an example, the field coils are sometimes divided and are connected in series with the armature but on either side of it, as seen in the diagram, Fig. 10A. When modifying a motor of this type it may be found to be running in the wrong direction. To reverse a series-wound machine, all that is needed is to change over the field connections, as seen in Fig. 10B, connecting the ends *A* and *D* of the field coils to the armature and the opposite ends of *B* and *C* to the mains. In re-making these connections it may be necessary to lengthen some of the leads from the field windings. In this event, care must be taken to provide a sound soldered joint for the wire and to secure the leads firmly by means of insulating tape.

Methods of Suppressing Radio Interference

Reference has already been made to the interference that series-wound a.c. motors, or indeed any motors having a commutator and brush-gear, may cause to wireless reception if steps are not taken to get rid of this nuisance.

Most readers will be only too familiar with the audible results of radio interference. Speaking in general terms, the trouble may be said to result from sparking that takes place between the brushes and the commutator ; the greater the amount of sparking the worse will be the interference. A simple method of suppressing the noise is illustrated in Fig. 11. As will be seen, a pair of condensers, each of 0.1 mfd. capacity, are connected across the brushes and are earthed in the manner shown. It should be noted that all condensers used for this purpose must be of a type tested to withstand 400 volts, otherwise they may break down in service.

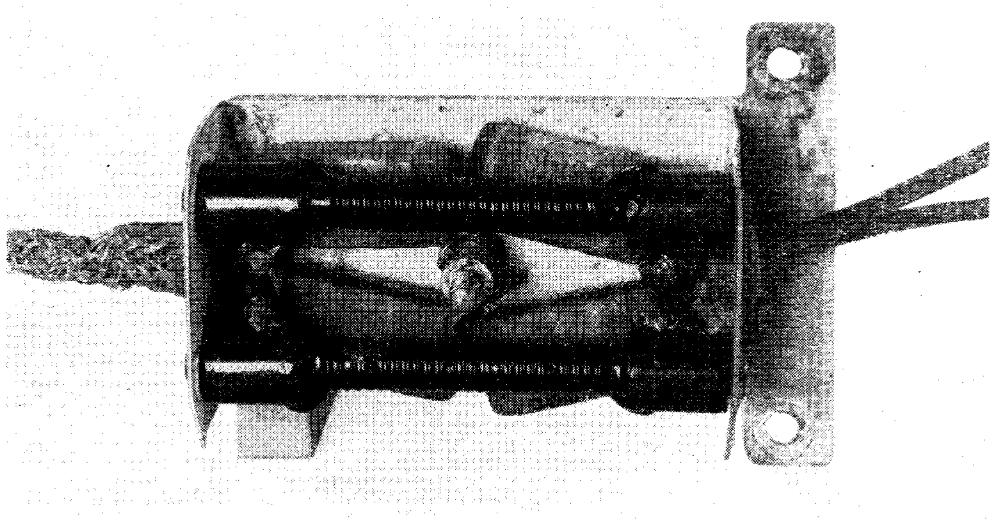


Fig. 12. *A suppressor unit for use with* 24 *volt d.c. motors*

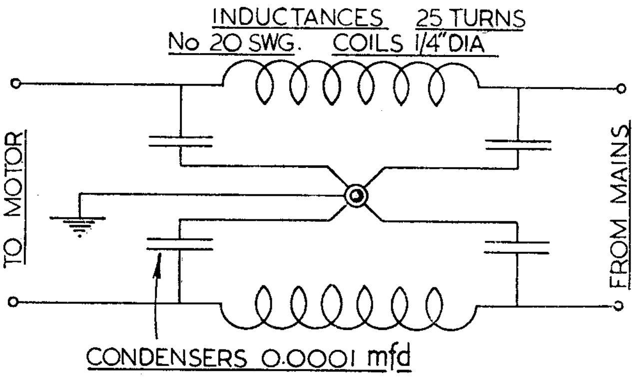


Fig. 13. *Wiring diagram of the suppressor unit illustrated in Fig.* 12

This method of reducing the interference noise will be found adequate in most instances. Nevertheless, when a higher degree of suppression is needed, the device illustrated in Fig. 12 may be adopted. The suppressor shown here is one taken from an electric motor fitted to some military equipment working on 24 volts, d.c.

As will be seen from the wiring diagram, Fig. 13, an inductance is placed in each leg of the mains wiring and that the ends of both inductances are connected to earth through condensers of 0.0001 mfd. capacity. In addition, the leads connecting the suppressor unit to the motor are screened by a braided metal sheath ; part of this sheath may be seen to the left of the illustration.

The braided covering serves also for earthing the motor to the metal case of the suppressor, which is itself earthed.

The particular unit illustrated is small and neat, measuring $2\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × 1 in. only. It is doubtful, however, if the small condensers seen in the illustration could be subjected to a pressure of 240 volts without breaking down Suitable condensers would have to be employed, therefore. With regard to the screening of the electrical leads ; in most instances this may be omitted, provided that, as has already been emphasised, the motor is, itself, properly earthed. Screening of this nature is necessary only when the motor is working close to sensitive radio equipment.

PRACTICAL LETTERS

Steam Still in Vogue

DEAR SIR,—Your mention in " Smoke Rings " of the three tug boats, reminded me that I have just seen one in the Huskisson dock. The one in question is the *Canada*, a ship of 1,200 i.h.p. ordered January 1951, and other particulars as you mention. The motor (diesel) tug does not seem to make much headway on Merseyside, the tug owners rely on the old and trusted servant—the steam tug.

Mention of the steam wagon by Mr. W. Boddy and the overtype in particular, the only firm in the Merseyside, as far as I can tell, who still run these machines is a well-known road making concern.

The wagons, " Foden " six-wheeled, are fitted with a large coke-fired tank for bitumen. Overhead shafting is operated from the fly-wheel of the engine driving the mixer. I did hear they are an enormous asset to the owners. There are quite a few undertypes in operation, Sentinel and Strype, owned by haulage contractors

The " Foden " as photographed, owned by Camroux of London, appears to be one of the six-ton flat platform type converted to tractor, about 1928. There were hundreds of these machines on the roads of London, quite a number owned by brewers alone.

It would be interesting to know if there are any showmen's engines (road locomotives) in active service; I have seen none of these fascinating machines since before the last war.

Yours faithfully,

Liverpool. A. EDWARDS.

Re : Steam Organs

DEAR SIR,—I was very interested to see from the April 24th issue that you have had many interesting letters on the above subject. I, too, have had two, also telling me for the first time that they were known as " Calliopes."

My curiosity then took me into Nuttall's Popular Dictionary where I read the following definition of Calliope . . . the muse of eloquence and heroic poetry (Myth.) (Gr. *kallos*, beauty, and *ops*, the voice) ...... which I think you will agree is a great compliment to King Steam

Yours faithfully,

Brighton. S. R. BOSTEL.

Electronic Organs

DEAR SIR,—Having recently built a copy of the Solovox which is a single note, three-octave, multitone instrument, I have watched fellow readers' answers to Mr. Siddons with interest.

So far the replies have tended to make the problem seem mountainous and I hasten to reassure Mr. Siddons that *it can be done* !

The book already suggested, viz. *Electronic Musical Instruments* is dear but very useful indeed. It includes the full circuit for the Solovox from which a copy can be made and does give very pleasing results.

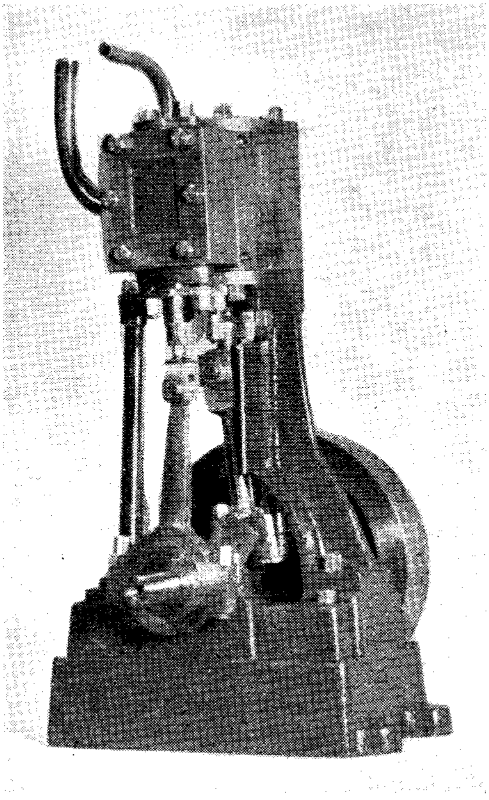
Also, one can write to the author, Alan Douglas, c/o Pitmans, and he is most helpful and will, for a fee, supply full details on the construction of any electronic instrument.

Yours faithfully,

Bexley. R. V. DAVIES.

A Beginner's Steam Engine

DEAR SIR,—I have been a member of the Vancouver Model and Experimental Engineers for the past year and not long ago purchased a set of castings for the Stuart No. 4 vertical engine. This engine was completed in my spare time in ten weeks. Upon its completion I took it to the next meeting of our club and it passed with flying colours—in fact, they were amazed that a novice lathe-hand could complete it in such a short time, as I also have other regular employment. I'm quite proud of the fact that the engine will run by blowing into the steam intake.



The members of the club thought that you would be interested in this little story, along with a picture of the engine, which was taken and printed by Mr. Denny Alton.

Yours faithfully,

Vancouver. ALFRED L. SIMONS.

Identifying Stainless Steel

DEAR SIR,—In your issue of March 27th, there is a paragraph concerning tests for stainless-steel.

It is stated therein that stainless-steel is, for all practical purposes, non-magnetic. I beg to differ—" S.80 " is, in common with many Martensitic stainless steels, very strongly magnetic.

May I outline my own method of checking an unknown steel?

First, try it with copper sulphate. If there is no deposition, then the stranger is undoubtedly stainless. Then use the magnet—if there is little or no response, it is of the " Austenitic " family. If it is magnetic, then it is " Martensitic." Incidentally, many " high speed " steels are stainless.

A further identification of non-stainless steels is easily made by trying the sample on the emery wheel. Generally speaking, a very bright white spark, with a feathery effect indicates high carbon content. Certain of the very excellent " K.E." range of steels have a dullish red spark with a small white centre, not unlike the spark given by cast-iron. I would suggest that an hour or so devoted to a few checks as outlined above would be very valuable to any model engineer, and a range of samples of *known* steels kept for comparative tests.

Yours faithfully,

Hillingdon. G. RUSSELL JACKSON.

Constant Voltage Transformers

DEAR SIR,—I notice that in your reply to Query No. 9936 you state that no transformer can give a constant voltage output when the input voltage is fluctuating.

This is not quite correct, as by arranging the primary inductance so that the core is magnetically saturated, it is possible to obtain a $\pm$ 1 per cent. variation in output voltage (at constant load current) for an input voltage variation of about $\pm$ 15 per cent.

The actual input variation permitted in any particular example, depends upon what fraction of the nominal input voltage will *just* saturate the core.

E.g. in one wound for a nominal 250 volts, and $\pm$ 10 per cent. fluctuation to be " absorbed," the inductance of the primary would be reduced until 90 per cent. of the nominal voltage, i.e. 225 volts, would just saturate the core. The secondary coil, if spaced *away* from the primary, could not, then, develop any increased voltage when the primary voltage increased. The upper limit of primary fluctuation is controlled by the d.c. resistance of the primary winding, as over the saturation point, increase in primary voltage gives a relatively large increase in primary current. (The primary behaves almost as a non-inductive resistance regarding the excess voltage.) For this reason, primary d.c. resistance is made higher than usual.

Calculation of correct primary winding for this type of transformer is very involved. The best way is to connect up a normal transformer to the mains, through an a.c. ammeter (or suitable lamp) and reduce the primary turns until a small reduction in turns gives a large increase in primary current. This should be done with a load on the secondary equivalent to final working load. Having found normal voltage saturation point, reduce the primary turns by the 10 or 15 per cent. required and the secondary turns to adjust the output voltage. This gives an approximately correct " constant output " transformer.

Yours faithfully,

Stockport. L. WARBURTON.